# INDUSTRIAL ARTS and VOCATIONAL EDUCATION

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## THE MONTH OF AUGUST

The dog days are upon us, yet in spite of the heat, humidity, mosquitoes, and the rest of summer's blessings, next year's duties are obtruding themselves into the waking and sleeping hours of shop teachers now at summer school, in the mountains, at the seashore, on lake or river, or on sight-seeing tours through this glorious land of ours.

To help teachers who are groping for something with which to improve their work next year, the August issue of INDUSTRIAL ARTS AND VOCATIONAL EDUCATION offers a variety of suggestions that can be easily adopted or adapted.

Those who are interested in related material may find valuable information in "Supplementary Related Material," by Reagh, "Foreign Wood Carving," by Sowers, and "The New Industrial-Arts Metal," by Hobbs. Those interested in camp crafts will be pleased with the article on "Arrows," by Hunt. Manzer's "Spinning a Pewter Bowl" will interest the teacher of metal work or of general-shop work. "Arranging the Tools" by Yager will be found helpful by every shop teacher. Other projects have been chosen with a view of showing what some teachers have done in the way of making utilitarian equipment which systematizes or makes easier some phase of their shopwork.

Woodworking teachers will find the supplement on the "Cricket" by Sowers very useful, while drafting teachers may welcome the supplement on the "Alphabet" by Conners and the educational game "Visualize" by Kellogg.

## THIS MONTH'S COVER

The picture chosen for the August cover is taken from the book *The Human Relationship* which was published in Holland in 1695. A free translation of the verse beneath the picture follows:

### THE PRINTER

It may be that my wish comes true,
To strike a good print off this plate,
Though often it does happen, too
That I make errors in my work.

*Articles Indexed*—The articles contained in the Magazine are regularly indexed in "The Reader's Guide to Periodical Literature," and "Education Index."

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*Editorial Contributions*—The Editor invites contributions bearing upon Industrial Arts, Vocational Education, and related subjects. Manuscripts, drawings, projects, news, etc., should be sent to the Publication Office in Milwaukee. Contributions are paid for at regular space rates. In all cases manuscripts should be accompanied by full return postage.

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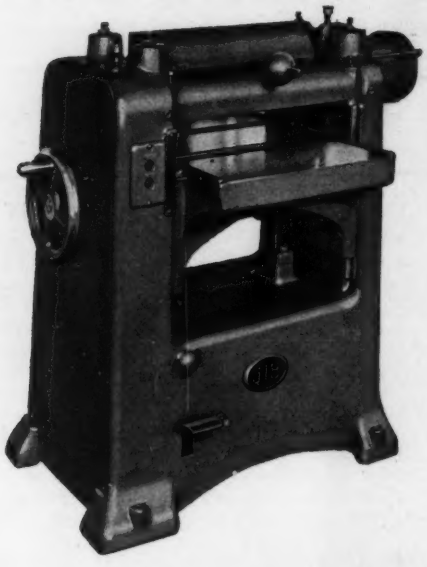

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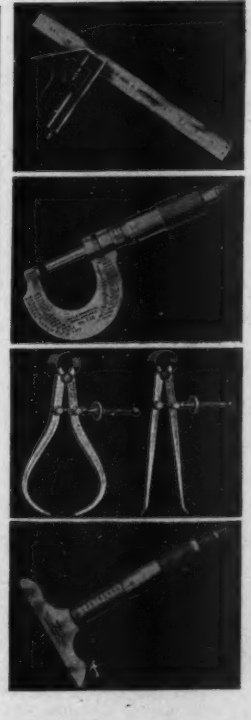

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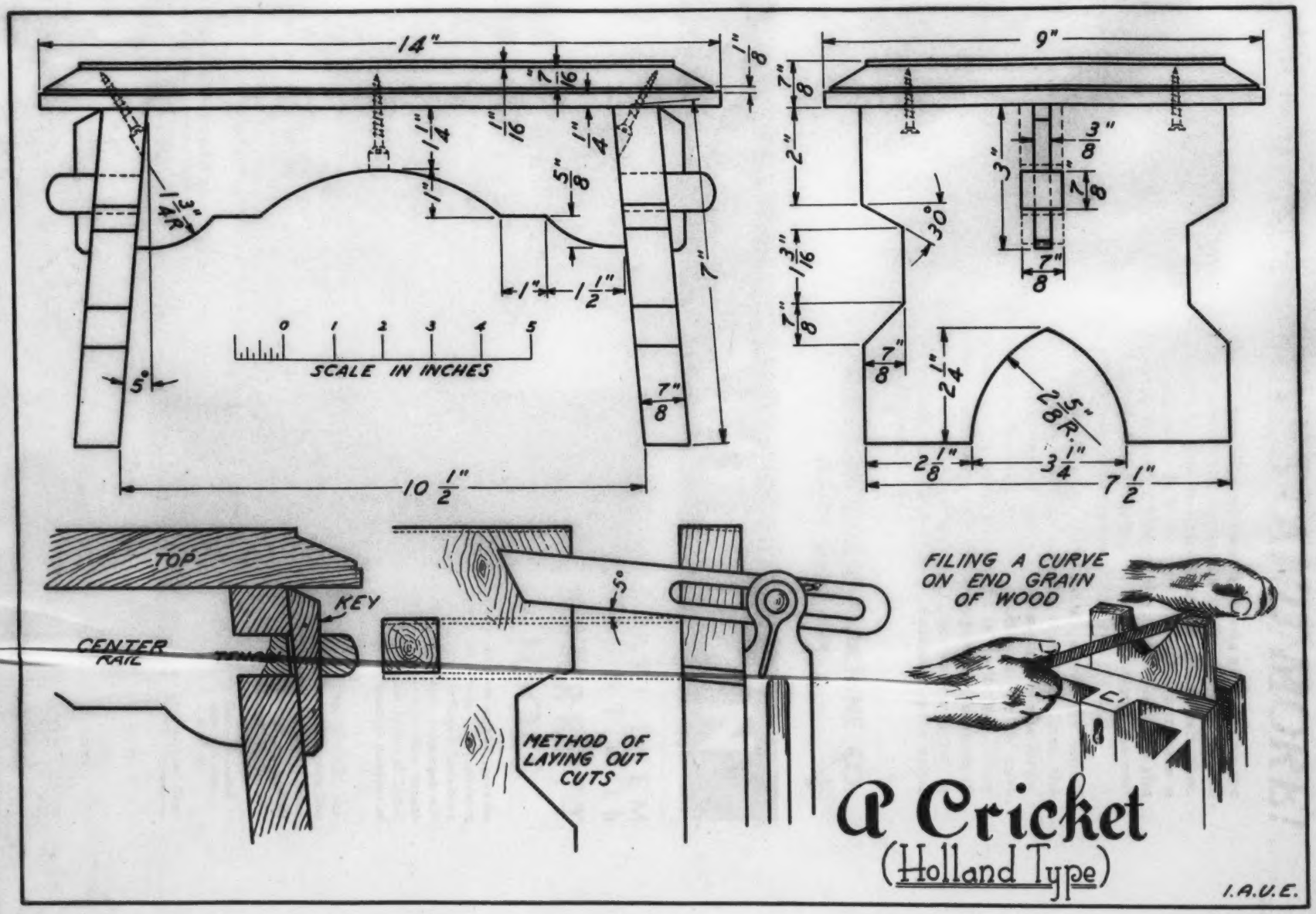


Designed by J. I. Sowers, Miami, Florida

(Described elsewhere in this issue)

Designed by J. I. Sowers, Miami, Florida

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JUL 1
DETROIT

Submitted by Tom R. Conner, Petaluma, California

August, 1935
Vol. 24, No. 8

INDUSTRIAL ARTS and VOCATIONAL EDUCATION

# Supplementary Related Material

## Arthur L. Reagh

*Supervisor Industrial Arts,*
*Grand Rapids, Michigan*

*Improving industrial-arts work is the duty of everyone connected with this type of work in the school. This article shows how one man has succeeded in an ingenious manner to make a part of this work interesting to his students.*

THE new concept of industrial-arts teaching has led to the enrichment of the courses by the use of related material or, as some choose to call it, supplementary information. It has been a troublesome problem to decide just what to include and what to exclude since there is so much of it.

Since it can only be hoped to scratch the surface at best, it is extremely important that what material is presented should be done in as effective a manner as possible. Some teachers have been very successful in selecting and presenting such information by the use of unique teaching devices. A few of these will be discussed in this article.

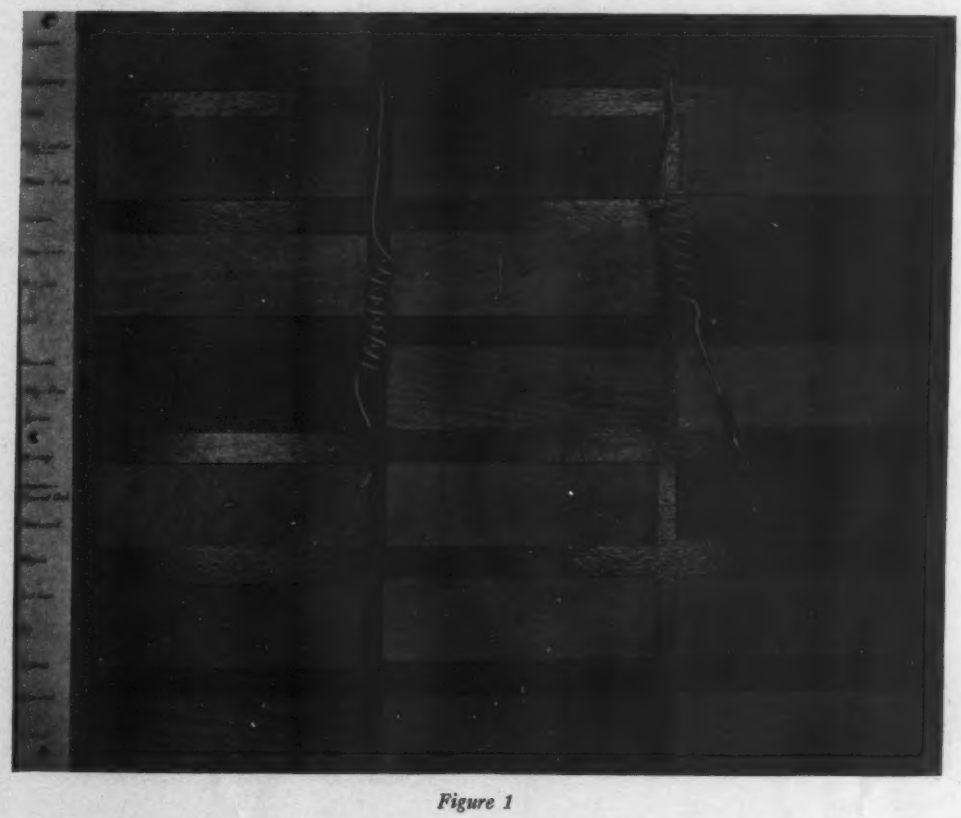

*Figure 1*

The first question many ask is, "What is supplementary material?" This may be defined as any information which explains and amplifies but is not absolutely necessary to the particular course from the skill, or manipulative standpoint. It is that information which gives the course a tie-up with the field of industry. This information is the material that helps correlate the industrial-arts work with actual life experience.

The woodworking courses are tied up to woodworking and allied industries by the use of such material. Courses in metal work, machine-shop practice, electricity, and printing may likewise be tied up with their fields. This might be further explained by saying that this related material gives the student a bird's-eye view of the industries.

Those who question the teaching of such material are not

familiar with the industrial-arts objectives. This is a changing industrial age, and if people expect to get along in it they must be industrial-minded. Pupils should be given opportunities to explore many fields in order to make a wise choice of the future activities. They need much information and many experiences in order to adjust and readjust themselves to this ever-changing age.

The old-time shop teacher who just taught *making things* is fading out of the picture. If he wants to continue teaching, he must realize that he must motivate his work by building into it the information and experiences that will give value. He must be aware of the avocational as well as the vocational needs of the pupil.

Harold Buckham, one of the instructors in the Burton Junior High School at Grand Rapids, has been very resourceful and successful in his representation of this related material. Some of the teaching devices used by him are shown in Figures 1, 2, and 3.

The three panels shown are intended to teach indentification, uses, growth, and production of wood.

The study of wood is introduced by requiring each boy to record in his notebook certain definite items of information about many of the commonly used woods. Among others, the following items are included in this study:

1. Color (heartwood and sapwood).
2. Grain (open, close, straight, curly, etc.).
3. Weight.
4. Hard or soft.
5. Locality where grown and harvested.
6. Uses.

Figure 1 shows a panel containing 21 different kinds of commonly used woods.

Care is taken to choose a typical sample of wood which is large enough to portray each characteristic clearly. On the left of the panel are placed the names of the different varieties arranged alphabetically. A screw is put through the wood at each name. The end of this screw, where it comes through the back, is connected by a fine wire to a screw coming through the corresponding wood. A door buzzer and dry cell also are fastened at the back and one binding post of each connected. The loose ends of the wire shown at the front of the panel are attached to the other connections of the buzzer and dry cell. When the terminal of one wire is placed on the screw at the name of any variety of wood and the other is touching the screw in the corresponding sample of wood, the circuit is completed and the buzzer sounds. The panel may thus be used at the close of the study as a testing device to determine each boy's ability to recognize the wood which he has studied. This test differs from most others and is very interesting as it may be made a competitive game among the members of the class.

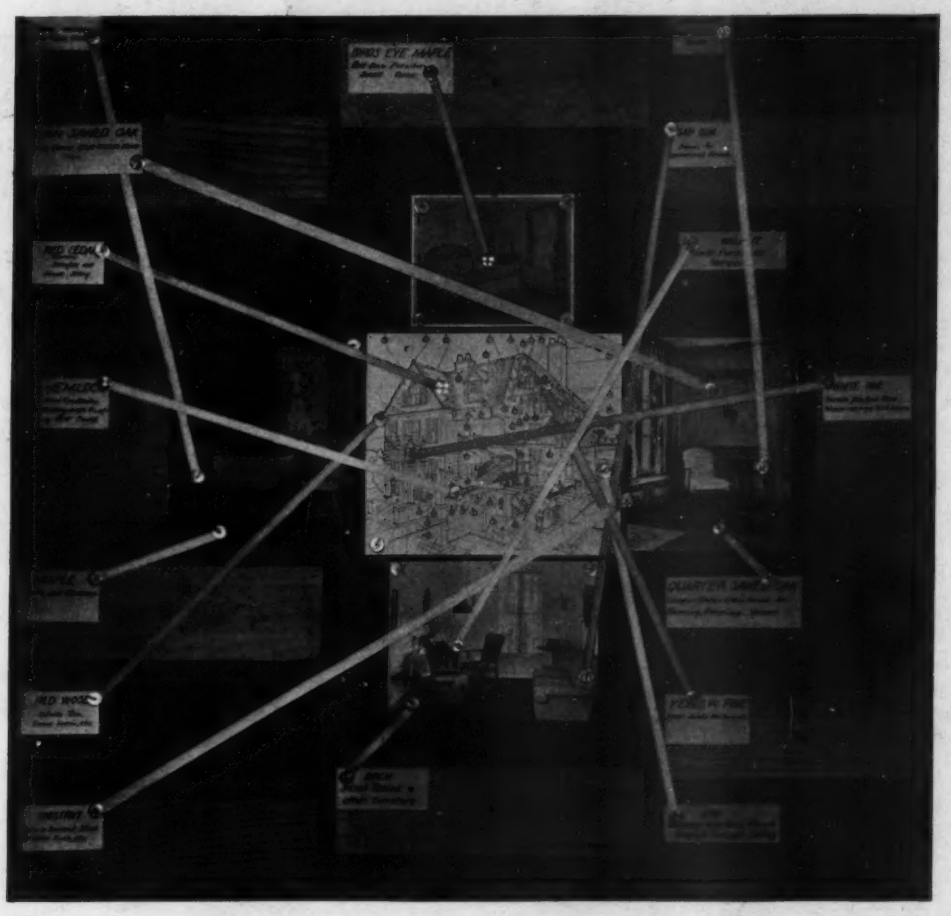

*Figure 2*

Figure 2 shows the samples of wood arranged about the border of the panel, and streamers reaching from each sample to a place in the skeletonized picture of a house to show whether that particular kind of wood is used in the structure or in the furniture.

Figure 3 shows a panel depicting the "mighty oak." This is an extremely interesting exhibit, and is a teaching device that correlates with many subjects. The original purpose was to teach facts about the growth of the tree and the produc-

tion of lumber, but so many useful related facts were developed that the panel answer many purposes.

First it was necessary to find a tree that was to be cut down and then get permission to saw off a section. This was finally accomplished on a Saturday and provided an excursion into the woods. The green section was allowed to air-dry for a time, and then was taken to the shop and pieces sawed out so as to show all methods of cutting lumber, such as plain sawing, quarter sawing, and so on. These pieces were held in place on the panel by means of dowels, so that the cell formation and grain could be recognized. Different colored paint was used to point out heartwood, sapwood, cambium layer and bark.

One of the most interesting points was the method of pointing out the annual rings. Each boy was assigned a certain ring and asked to letter on a card some noteworthy event of the year the ring grew. Each card was tacked to the border of the panel and a ribbon running from it was tacked to the ring. While these cards cannot be read in the illustration, they nevertheless tell a very interesting story beginning with 1865, the year of the growth of the first ring and ending in 1934 when it was cut down.

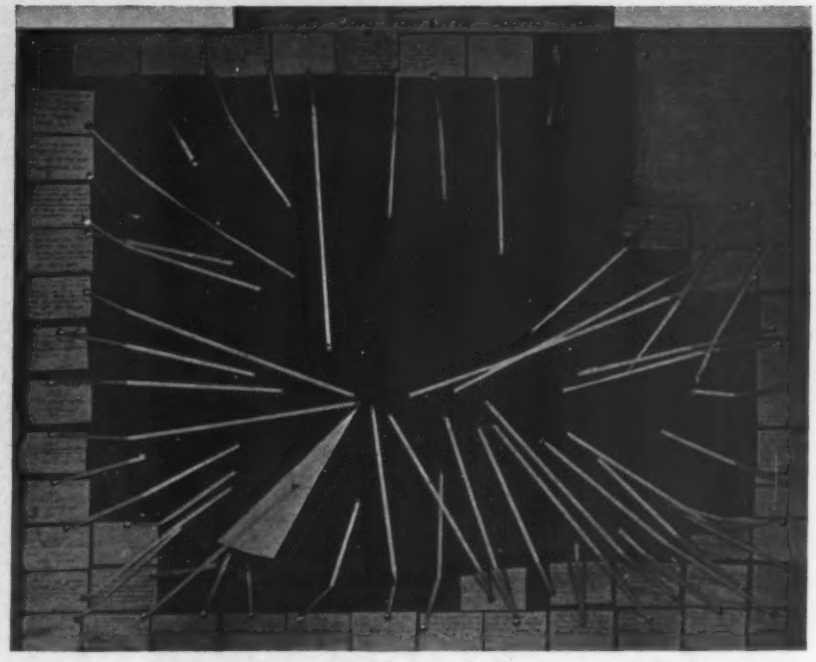

*Figure 3*

The research necessary by the boys to obtain all of this information was very educational. This was followed by each boy writing the entire story. Here, then, is a tie-up with history and English. The knowledge about wood creates a love and respect for this material which can be used as a basis for the teaching of facts about conservation of forests.

The study of the location of woods fixes geography in the mind of the student, and finally the knowledge of the proper use of woods teaches the buyer to use more discrimination when buying and selecting furniture and other articles made of wood.

# Arranging The Tools

## Sylvan A. Yager

*Indiana State Teachers College,*
*Terre Haute, Indiana*

*A list of factors to be considered when planning the placing of tools on a tool rack, in a tool cabinet, or in a toolroom.*

AS A RESULT of my observation of the various arrangements of tools in toolrooms, tool cases, and bench drawers, some of which were unusually good and others very poor. I have asked myself this question: What factors should be considered or what criteria should be applied in arranging and placing tools in the toolroom?

An analysis of the problem led to the development of the following factors which I think should be considered in the arrangement and placing of tools in the toolroom.

If some of these factors appear to contradict each other, the best judgment of the teacher will enable him to decide the matter in the light of an analysis of his own situation and needs.

1. Place tools that are used most frequently in the most accessible position.

2. Place tools, that are to be used by boys from several different grade levels, so that the boys in the lower grades can reach them.

3. Group tools so that the tools used in one activity are together instead of being scattered all over the toolroom.

4. Tools used in several activities might well be used as the nucleus in the arrangement of the tools for these related activities.

5. Arrange tools so as to provide the maximum amount of protection to expensive and delicate tools.

6. Arrange tools so their distinguishing characteristics can be seen easily.

7. Arrange tools so that no tool or tools will have to be removed in order to secure another tool.

8. Group together tools of the same class or type, such as cutting tools, measuring tools, boring tools, etc.

9. Only tools of the same kind or type should be placed on the same hook or fastener.

10. Arrange tools so that no element of danger will be incurred in removing them.

11. Sharp points and edges of cutting tools should be covered and protected.

12. Arrange tools so that they will not be damaged when they or the tools below or above them are removed or replaced.

13. Arrange tools so as to conserve space, but do not place them too close together.

14. Insofar as possible, arrange tools so that their positions will not have to be shifted in order to be removed.

15. Arrange tools so that they can be placed only in one position when they are replaced.

16. Arrange tools so that future additions will be possible without entirely rearranging the toolroom. This can be done by designating large enough blocks of space for each of the different types of tools to provide for future additions.

17. All tools should be properly identified in the toolroom or on the tool panel so as to permit a hasty return of the tool to its proper place. There are two general plans that will prove helpful in this matter. One is to have an outline of the tool painted on the panel so as to indicate the proper place and position of the tool. The second plan is to have the name of the tool stamped on a metal tag or printed on a paper seal and placed so as to identify properly the tool and the place where it belongs. Many teachers find it desirable to use both methods, since the first makes possible a return of the tools to their proper places and positions, and the second assists the students in learning the names of the various tools.

18. Arrange tools so that the general layout will present as pleasing, attractive, and neat an appearance as possible.

19. All hooks, hangers, or fastening devices used to hold or support tools should not only be strong enough to hold the tool, but also to hold it in its proper position.

20. Any device used to hold or support the tools should permit the tools to be easily removed and replaced without injury to the individual, to the tool being removed, or to other tools in the immediate vicinity.

21. A tool should not have to be forced or jerked when it is being removed from its position, nor should force be necessary to return it to its proper place.

22. A slow, thoughtful procedure in arranging tools in the toolroom or on the tool panel, or in the tool case, may save considerable time in the long run, and prevent a constant shifting of tools until a final arrangement has been decided upon.

23. The watchword for the toolroom should be, "A place for every tool, and every tool in its place."

24. In a conspicuous place in the toolroom, post a complete list of all the tools contained therein.

# Foreign Wood Carving—I

## J. I. Sowers

*Director Industrial Arts, Miami, Florida*

*Some good illustrations of wood carving secured by the author in a study of what is being done in the teaching of the art in the schools of foreign countries.*

SINCE the author's series of articles on wood carving appeared in this magazine last year, he has received frequent requests for more material on this subject. Even before the original series of articles was published, he was studying the wood carving carried on in the schools of foreign countries. The United States Office of Education was quite helpful in assisting him to make proper contacts with ministers of education and heads of schools in these countries. As a result he has gathered a large and extensive collection of photographs showing the work in wood carving as done in these countries, and also how the work is carried on in the schools.

Some of these photographs will be used to illustrate this and other similar articles which will appear later. From the illustrations it will be evident that some pieces were made by beginners, others by students well up in the mastery of the art of wood carving.

Figures 1 and 2 show a screen and a clock made by Ethel M. Farrall of Launceston Technical College, Tasmania, Australia. The screen is carved with a figure of the lyrebird common to that country. It will be noted how well the carver has shown the feathers on the bird. Carving within a design is known as "in lines." The design for the clock is perhaps not so well chosen, there being some lack of conformity between the round face of the clock and the carved design.

Figures 3, 4, 5, 6, and 7 are the work of Scottish schools, and were received from Mr. W. W. McKechnie, Secretary of the Department of Education, Edinburgh, Scotland. Figures 3 and 4 are decorative hall chairs, while Figure 5 shows a close-up detail of the carving on the backstay of the chairs. Figure 6 shows the carving on the seat. The seat carving seems to indicate that the chairs are for decorative effect rather than for use. The carving is in medium relief and is well designed to fit the space on which it is used. Enough information is given in these pictures to enable a copy of these interesting chairs to be made. Figure 7 is a lamp or hall table. The top and side panels are carved. The legs are gracefully shaped and afford a wide base.

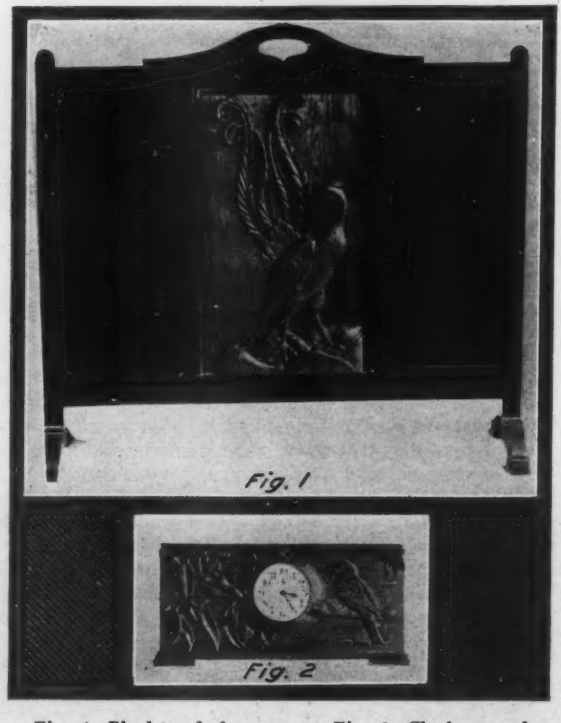


*Fig. 1. Blackwood fire screen. Fig. 2. Clock carved by a woman student in Launceston Technical College, Tasmania*

*Figs. 3 and 4. Hall chairs. Fig. 5. Carving details of backstays. Fig. 6. Carving details of seats. Edinburgh, Scotland*

*Fig. 7. Table. Edinburgh, Scotland. Figs. 10A and 10B. Refectory table. Senior classwork, Government Carpentry School, Allahabad, India*

*Fig. 8. Mirror frame in bas-relief carving. Vancouver, B.C., Canada*

Figure 8 is a mirror frame done in bas-relief carving. This work was done in the class of W. G. Donaldson, Vancouver, B. C., Canada, and received from John Kyle, Provincial Director of Technical Education, Canada. The design is rather well adapted to the piece and shows well-cut tool markings which the pupil has not been permitted to sand away. The work might be more interesting if the background had been cut away without stippling.

Figure 9 shows a group of three pieces. This work was done by girl students, aged 15, in the secondary schools of Madrid, Spain. These projects are from the first-year course in carving, and are rather well-executed examples of simple chip carving.

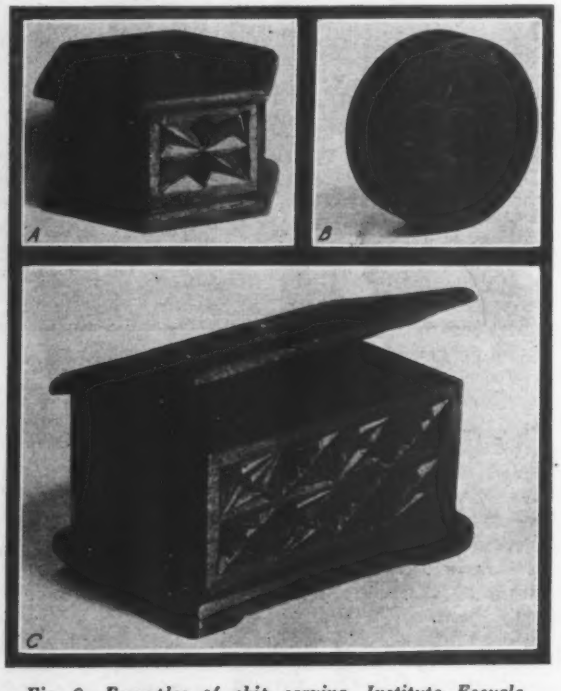


*Fig. 9. Examples of chip carving. Instituto Escuala, Madrid*

*Fig. 11. Jewel chest. Vienna, Austria. Fig. 12. Bride's chest. Villach, Austria. Fig. 13. Mirror frame. Prague, Czechoslovakia*

*Figs. 14 and 15. Louis XVI chairs. School of Carpentry, Lucknow, India*

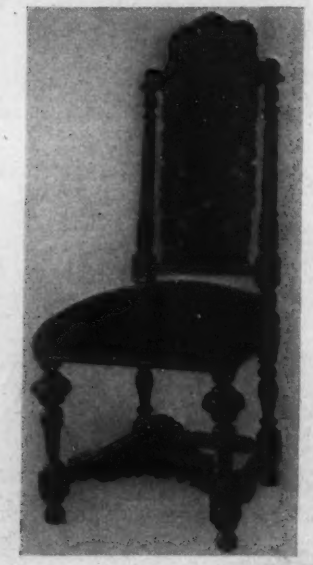

*Fig. 16. Jacobean chair. Bombay, India*

Bold cutting strokes are evident, which shows that the instructor is seeking to develop a good tool technique.

Figures 10A and 10B show two views of a refectory table. This work was done by the students in the senior class of the Government Carpentry School, of Allahabad, India. The bulbous legs of this massive table are specially interesting. The work on these legs is well executed, as is shown in the close-up detail. The treatment of the table rails is not so happily chosen but is fairly well executed.

Figure 11 is a chest of classical design and treatment. It is the work of the students of art in the schools of Vienna, Austria. It is a beautiful piece of work representing a very high degree of art in the treatment and execution of design in wood. The piece is a jewel chest and, as such, is an intimate object seen from a position close to the eye. The work on the box, therefore, requires a much finer execution and more careful working out of detail than if it were to be observed from a distance and from a different eye level. It will be noted that this work in construction, syntheses, and expression follows more closely that of the stonecutter than the worker in wood. The prominence of stonework in art up to the fifteenth century had a profound influence on wood carving. Wood carving during this period was also commonly painted, or treated to obscure the grain of the wood.

Figure 12 is a bride's chest executed in the schools of Villach, Austria. The photograph of this piece was received

from the Minister of Commerce and Transportation, Vienna. This chest is somewhat similar in design to Figure 11, but is executed in much bolder relief, and the figures more clearly outlined and developed. The wood construction is very evident. Again, as in the former, we see a repeat design used on the front, with the center of the chest as the point of major interest. It scarcely seems possible to improve the dimensions, the design, the layout, or the tool execution of this chest.

Figure 13 is a piece of work executed in the State School of Wood Carving, Prague, Czechoslovakia. This frame is decorated in a style known as *baroque* which came into being after the release from the dominance of symbolism during the Middle Ages. The motifs are taken from nature but are treated in a style unknown to their classic prototypes. The design is woven into a series of scroll movements, and modeled so as to produce the utmost play of light and shade as will be noted in the illustration. This style is very ornate, requires careful execution, but would seem to detract from the other objects by which it may be surrounded. Such treatment might be acceptable in a mirror frame, but not to frame a picture. The work, of course, required a high degree of skill and careful execution.

Figure 14 is a very ornate chair, and a well-executed piece of work, both in design and workmanship. It is a product of the students in the State School of Carpentry, Lucknow, India. The companion chair is shown in Figure 15. These chairs are of Louis XVI design, and are very good examples. They represent student work in the Lucknow school and are very good examples of carving, though lacking somewhat in clear-cut toolwork.

Figure 16 shows a Jacobean chair, from the art school of Bombay, India. This style flourished in England from the beginning to the middle of the seventeenth century. Underbracing with stretchers close to the floor was characteristic in this style. The elaborately carved back panel is typical of this type, and is an excellent piece of craftswork. Those who have studied the author's former articles on wood carving will recognize much of the work on this chair as *pierced-work* carving. Since the background is entirely cut out it permits the entire contour of the work to stand out in bold relief. Such work needs very careful drawing, as lack of balance and symmetry is readily apparent. This chair represents not only most excellent carving technique, but is an outstanding example of Jacobean reproduction.

In future articles we shall take up other forms of the art of carving in wood as influenced by the historic periods through which the art has passed, and the modifying bias of national life upon the art as expressed in the work now being done in the schools of foreign countries. The study of this work is far more interesting than that of museum pieces from the past. This study is a definite dip into the cultural artwork now being done in the industrial-arts and art schools of the world. Culture and art are but fleeting and unimportant, if they do not contribute in some measure to the welfare of mankind.

# The New Industrial Arts Metal—II

## Douglas H. Hobbs

*Pittsburgh, Pennsylvania*

*In this, the second of three articles on aluminum, the method of manufacturing this new industrial metal is outlined.*

LOCKED tightly in the compounds in which it occurs in nature, the most abundant of all the metals found in the earth's crust is the most recent to become an everyday metal of commerce. From the standpoint of tonnage produced and used, iron is the most common metal in the world. It is followed in turn by lead, copper, zinc, and aluminum. No one knows when the first three metals were discovered, and it can be said that their metallurgy dates back to antiquity. Zinc is between 300 and 400 years old. Aluminum, on the other hand, was not isolated until 1825, and did not become a common commercial metal until the latter part of the nineteenth century.

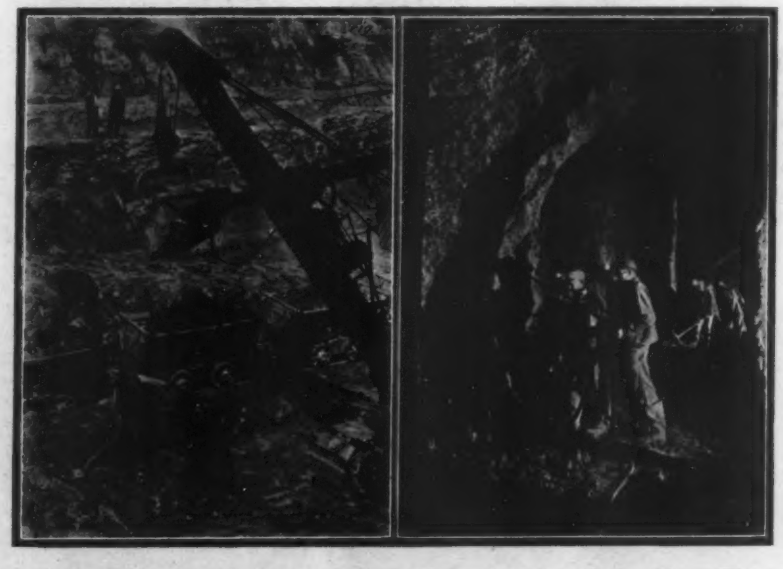

*Fig. 1. Mining bauxite, the ore of aluminum, by open-pit methods. Fig. 2. The underground mining of bauxite*

Almost paradoxically, geologists tell us that approximately 8 per cent of the terrestrial material in the world consists of aluminum, about 5 per cent of iron, and less than 0.02 per cent of copper, lead, and zinc. Why aluminum should have remained hidden in the earth's crust when metals less abundant were in common commercial use, can be attributed to the affinity of the metal for the other elements with which it is chemically combined. Never found in the native state, its compounds are principally the silicates and and oxides. Tremendous amounts of power are required to sever these chemical combinations, and although every clay bank and practically all of our common rocks contain aluminum in varying proportions, the metal is, at present, produced on a commercial scale from only one mineral—bauxite.

*Fig. 3. The impurities in the sodium-aluminate solution are filtered off in large filter presses. Fig. 4. The sodium-aluminate solution is pumped into gigantic precipitators. Fig. 5. Calcining the aluminum hydroxide to aluminum oxide*

Bauxite is a hydrated aluminum oxide containing as impurities the oxides of iron, silicon, titanium, and several other elements. It is used not only in the production of aluminum but in the manufacture of artificial abrasives, chemicals, refractories, aluminous cements, and insulating materials. Although the ore is found in many parts of the world, the principal bauxite-producing countries in order of their production are: France, United States, Dutch Guiana, British Guiana, Hungary, Italy, and Yugoslavia. In the United States, bauxite is mined in Arkansas, Georgia, Alabama, Tennessee, and Mississippi, but only that found in Arkansas is used in the production of aluminum.

Because of the manner in which bauxite occurs in nature, both open-pit and underground methods are employed in mining it. In general, the bauxite deposits follow the irregularities and abrupt changes of the rock upon which they rest. They may be at or near the surface, covered only with dirt and other foreign material, or they may be in beds interlaid with sedimentary rock. Occasionally, there are pocket deposits of bauxite or irregular masses enclosed within soft sandstone or clay.

If the ore outcrops on the surface or the overburden can be economically removed, the bauxite is mined by the open-pit method, shown in Figure 1. The area is cleared of timber and brush and the sediment above the bauxite is removed. The top crust of ore is generally scraped off and discarded because of its poor chemical composition, and after removing any clay pockets which may occur in the bauxite, the exposed surfaces are thoroughly cleaned. The ore is then mined by drilling and blasting.

When the bauxite deposit is too far underground to make it economical to mine by open-pit methods, shafts, main haulage and drainage ways, and entries are planned and located, and the work of developing an underground mine begun. As the ore body varies greatly in its characteristics in the different parts of an underground mine, the method of mining will differ materially. An underground mine is shown in Figure 2.

The bauxite, as it comes from the mines, is broken into small pieces, washed, screened, and dried. It is now ready for shipment to an ore purification plant where the impurities contained in it must be removed before it can be used in the production of aluminum. This is done by a wet chemical process; and while a number of processes have been devised for the purification of the ore, the Bayer process is most commonly used. In this process, the aluminum oxide of the ore is dissolved out by means of sodium hydroxide, re-precipitated as aluminum hydrate, and calcined to form pure aluminum oxide.

The bauxite from the mines is ground into a fine powder and stirred into a hot sodium-hydroxide solution. The caustic soda dissolves the aluminum oxide out of the ore to form sodium aluminate, but has practically no effect upon the oxides of the other elements which are present in the ore as impurities. The impurities, not being dissolved, are removed in large filter presses (see Fig. 3), and the filtrate is pumped into gigantic precipitating tanks, such as the one shown in Figure 4. By constantly agitating the solution in these tanks, the aluminum will in time separate out as aluminum hydroxide, just as a salt which has been placed in solution in hot water separates out as the solution is cooled. The aluminum hydroxide is then removed to thickening tanks in which any caustic remaining in the hydroxide is washed out, and by heating the hydroxide white-hot in massive, rotating, brick-lined kilns (see Fig. 5) to drive off all chemically combined water, it is converted into aluminum oxide or alumina.

The purified bauxite, which is now commercially pure aluminum oxide, is in the desired form for the production of metallic aluminum. Approximately two pounds is required to make one pound of aluminum. Another essential in the manufacture of the metal is electricity. About 12 kilowatt hours is consumed in the production of one pound of aluminum, an amount sufficient to keep a 40-watt light burning constantly for 12½ days. Naturally, then, aluminum-reduction works are located near the source of large quantities of electrical energy, and in this country they are situated at Massena and Niagara Falls, N. Y., Badin, N. C., and Alcoa, Tennessee.

In each reduction works, there are one or more batteries of electrolytic cells in which the alumina is reduced to aluminum. The cells are rectangular in shape and consist of steel shells lined with a suitable refractory material. Inner linings of carbon serve as the cathodes, while the current is led into the cells by carbon anodes suspended from overhead busbars.

The successful operation of the Hall-Heroult process for the electrolytic production of aluminum is based on the solvent action of cryolite for alumina, and the fact that alumina when dissolved in the cryolite can be decomposed

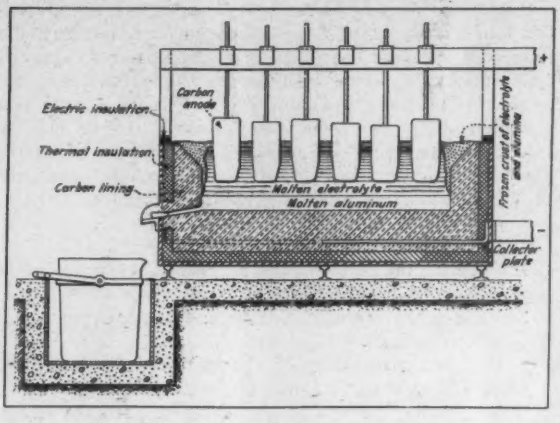


*Fig. 6. Diagram of a Hall-Heroud electrolytic cell*

by the passage of an electric current without change in the solvent cryolite. Cryolite is a sodium-aluminum-fluoride mineral found in only one commercial deposit — that in Greenland. It is quite possible, however, to make a synthetic cryolite which is the chemical equivalent of natural cryolite as far as the production of aluminum is concerned, and either synthetic cryolite, produced in the United States, or natural cryolite may be employed in the electrolytic reduction of aluminum.

In the operation of a Hall-Heroult electrolytic cell, like the one shown in Figure 6, the cryolite-bath material is first introduced into the cell. When it has been fused by the electric current, the alumina is added, and as the current is passed, the alumina, which has been dissolved in the cryolite, is broken down into its component parts of aluminum and oxygen. The oxygen liberated in the reaction combines with the carbon of the anodes, the resulting carbon monoxide and carbon dioxide escaping through the crust at the top of the cell where the carbon monoxide burns. About three-fourths of a pound of carbon electrode is consumed for each pound of aluminum produced. The molten aluminum is deposited on the carbon bottom of the cell and about every two days it is tapped into a large mixing ladle from which it is cast into pigs, as shown in Figure 7. Since the cryolite-bath material is not affected by the decomposition of the alumina by the electric current, alumina is added from time to time and the process is continuous.

The pure metal as it comes from the electrolytic cells contains some dross and electrolyte. These are removed by remelting the metal and again casting it in iron molds, this time in the form of ingots. If alloys, rather than commercially pure metal, are desired, the alloying may take place during this remelting operation. In either event, the remelted metal is ready for shipment to the various fabricating plants throughout the country.

The outstanding characteristic of aluminum is its light weight. Its specific gravity is 2.7, which is approximately one third that of the other common commercial metals. In color, aluminum resembles silver but possesses a characteristic bluish tinge of its own. It is unusually malleable and ductile and may be readily worked and shaped. It is little affected by moist air, chemical fumes, sulphur gases and the like, a property attributed to the immediate formation of a film of oxide on its surface which, once formed, effectually protects the metal underneath. Its melting point is 660 degrees C. (1220 deg. F.). It possesses high thermal and electrical conductivity and high reflectivity for visible and ultraviolet light. Its radiating power for heat is low.

Commercially pure aluminum has a tensile strength of about 14,000 lb. per sq. in., but by rolling or by other cold

*Fig. 9. Pouring a large aluminum-alloy sand casting*

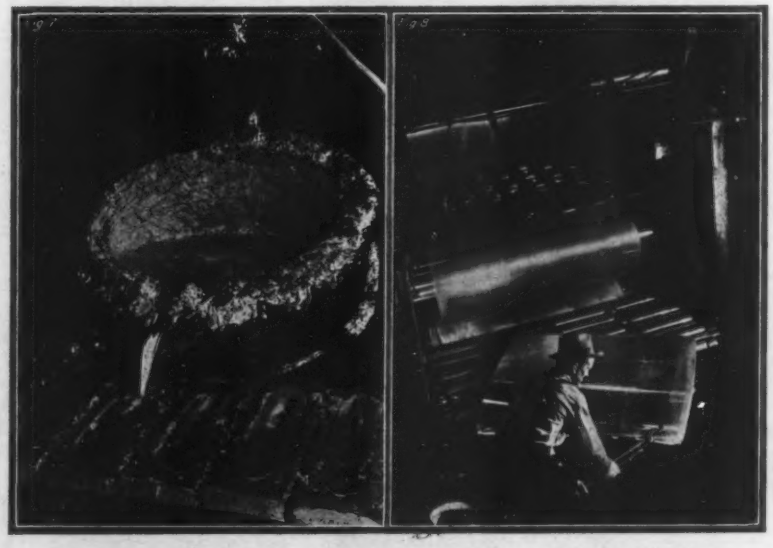

*Fig. 7. Pigging aluminum. Fig. 8. Hot-rolling aluminum-alloy sheet*

working processes, its strength may be increased approximately 75 per cent. By alloying aluminum with other metals, and by the use of heat-treatment processes, the tensile strength may be raised to as high as 65,000 lb. per sq. in., or in other words, to within the strength range of structural steel. The principal alloying elements are copper, silicon, magnesium, manganese, zinc, and nickel.

Ingot is the bulk form in which aluminum and aluminum alloys are sold. There are, however, different types, sizes, and forms and these depend upon the use for which the metal is intended. The ingot used in foundry practice will differ in size and form from that employed in the rolling of sheet or in the production of extruded shapes and forgings.

Three types of castings can be made from aluminum alloys; these include sand castings, permanent mold castings, and die castings. As the name implies,

sand castings are produced in sand molds, such as the one shown in Figure 9, while permanent mold castings and die castings are made in permanent metal molds or dies. For small-quantity production and the production of extremely intricate castings, as well as for the production of large castings, the sand casting process is employed. For quantity production of parts requiring a small amount of machining, or of parts on which it is desired to eliminate machining entirely, the die casting process is used. When soundness is the prime requisite in the casting, it is usually made by the permanent mold process. Briefly, then, the three casting processes may be summarized as follows: the sand casting process is characterized by its universal adaptability; the die casting process, by its extreme dimensional accuracy; and the permanent mold process, by its metallurgical superiority.

The ductility and malleability of aluminum make it particularly adapted to such metal-working processes as rolling (see Fig. 8), forging, extruding, drawing, and spinning. These properties of the metal are also maintained in many of the aluminum alloys. Plate, sheet and foil, bar, rod and wire, tubing, and molding are regularly produced in aluminum and its alloys, although foil (sheet less than 0.005 in. thick) is generally rolled from the pure metal. Structural shapes, either rolled or extruded, and forgings are usually made in the strong aluminum alloys, since, for the purpose for which they are intended, strength is a desired asset.

Possibly no other metal can be obtained in as many diversified forms as aluminum. Its basic commodities include those fabricated by every known metal-working process, while its applications range from wrist watches, bracelets, beads and mesh bags to dump trucks of 25 tons capacity; and from collapsible tubes for tooth paste, shaving cream, and the like, to railroad cars and trains. This, however, is another phase of our story and it will be told in a subsequent issue of INDUSTRIAL ARTS AND VOCATIONAL EDUCATION.

### Questions for Discussion

1. What is the most abundant metallic element in the earth's crust?
2. What is the ore of aluminum and in what countries is it chiefly produced?
3. Of what does the ore of aluminum consist chemically?
4. How is the ore of aluminum mined?
5. Why can't the ore of aluminum be used directly in the manufacture of aluminum?
6. Describe the Bayer process.
7. Where are aluminum-reduction works generally located?
8. Describe the electrolytic cell used in the manufacture of aluminum and its operation.
9. What are some of the outstanding characteristics of metallic aluminum?
10. Name some of the basic aluminum commodities.

# Spinning a Pewter Bowl

## E. W. Manzer

*Bronxville, New York*

*Spinning metals furnishes a fascinating hobby which may be practiced in the school or in the home shop. The project described by the author is made of pewter.*

METAL spinning is one of the most fascinating phases of the new industrial-arts subject — pewtercraft. Instructors of the industrial arts, who, because of their many activities, find it somewhat difficult to adopt a real hobby, will find the spinning of metal a hobby of real merit and a valuable subject to add to their general shop. It offers many challenges, but that is one of the attributes of a real hobby.

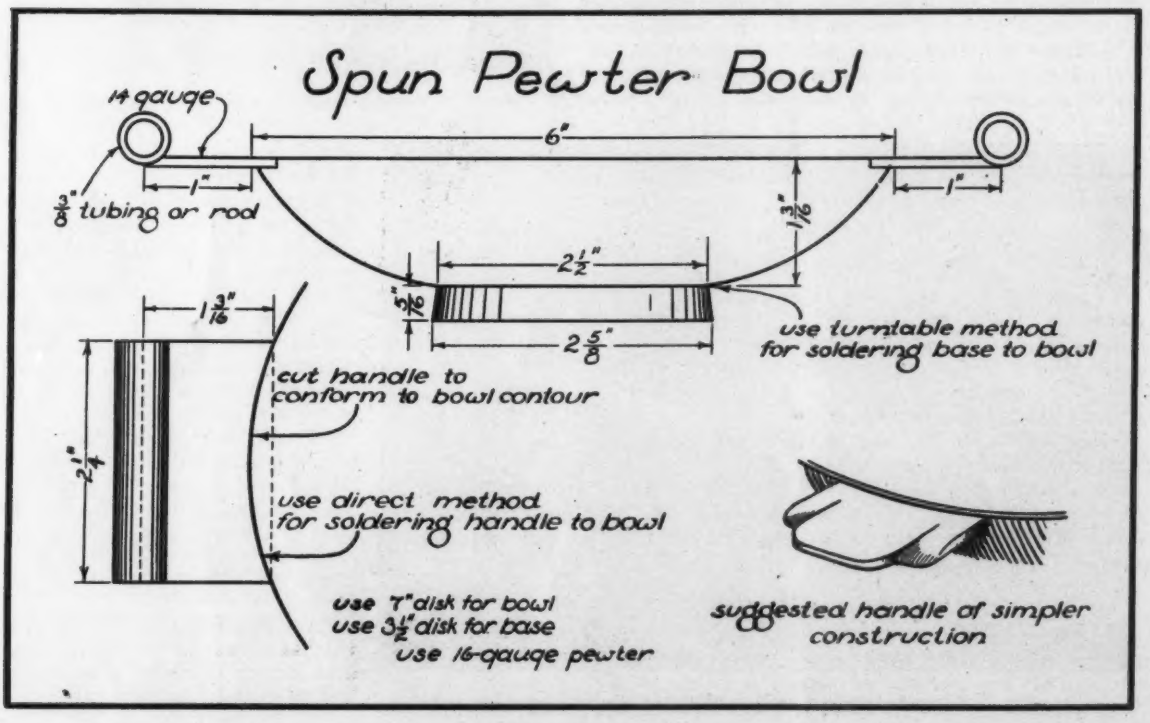


*Fig. 1. Spun pewter bowl*

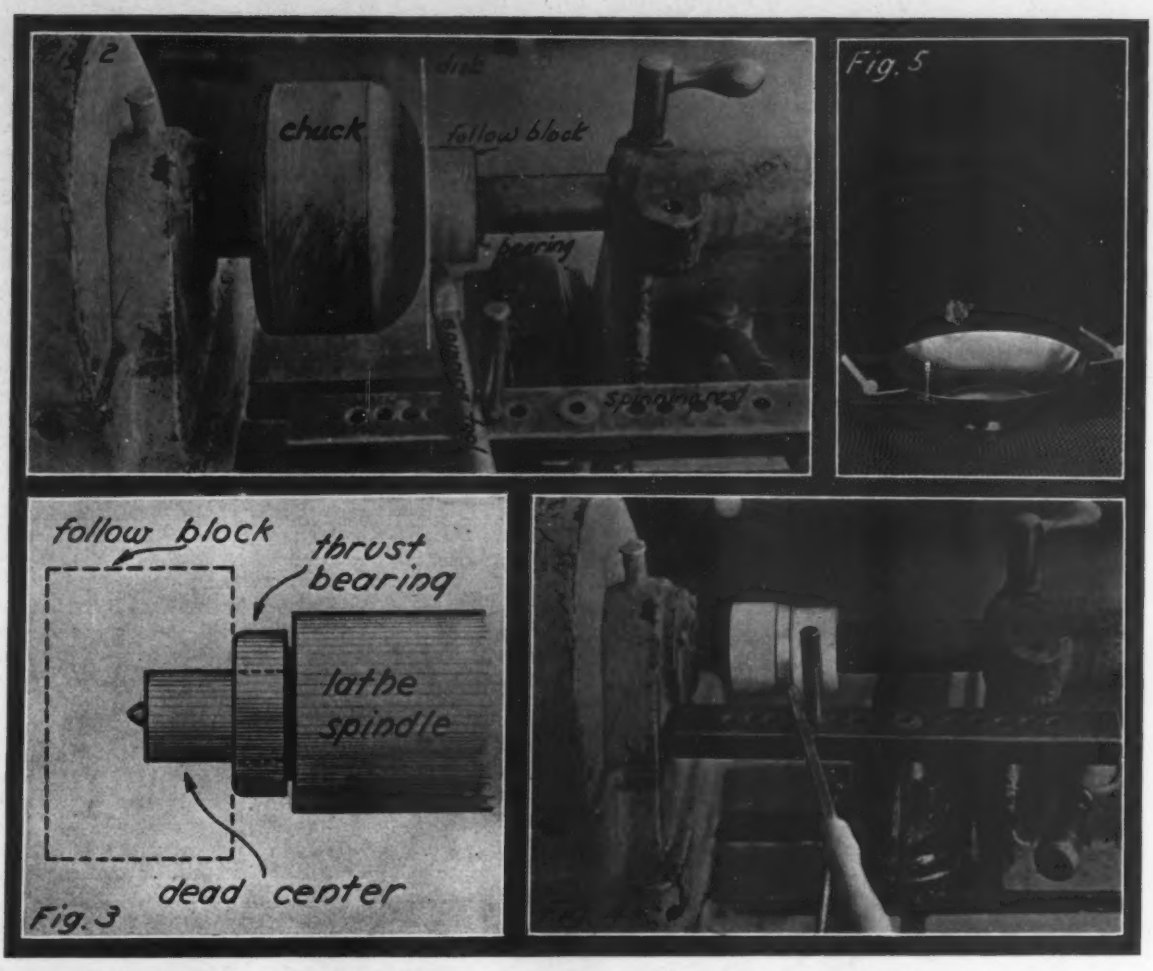


*Fig. 2. Setup for spinning the bowl. Fig. 3. Follow-block thrust bearing. Fig. 4. Setup for spinning the base. Fig. 5. The finished bowl*

Practice, with patience, perseverance, and a desire to master new processes, will enable one to spin practical projects for the home or for commercial purposes. Many simple projects may be spun by boys or girls. Experience has proved that this can be done with great success. Spinning is an industrial process that should be taught to students so that they can distinguish between the handwrought and the manufactured ware which they will ultimately purchase.

### The Spinning Chuck

To spin the bowl shown in Figure 1, requires several preliminary lathe jobs. First of all, the spinning chuck must be turned. Cut a circular block of birch or maple, 1½ in. or more in thickness by 6¼ in. in diameter. This block may be fastened to a faceplate, or it may be drilled and tapped to fit the lathe spindle. If the latter is done, it will be easier to use the chuck without fastening it to a faceplate every time it is wanted. The block is turned to fit the inside of the bowl to be spun. The base of the bowl should be kept flat so that there will be enough surface to hold the disk of metal in place when the follow block is drawn up to the metal disk. See Figure 2.

### Follow-Block Thrust Bearing

In order to permit free turning of the follow block, a thrust bearing of some sort must be used. The hole in the thrust bearing should be just large enough for the dead center. Place one face of the bearing against the dead-center spindle, and against this bearing place the follow block. See Figure 3. It may be necessary to make a collar to compensate for the length of the dead center, thus eliminating a long follow block.

### The Follow Block

Note how the follow block in Figure 2 is holding the disk in place against the chuck. This is done by the pressure of the tailstock on the follow block. To make the follow block, turn a piece of soft pine or gum to a diameter of 2½ in. Drill a hole in the center of the block large enough for the dead center to fit freely, and deep enough for the block to rest against the thrust bearing. Bring the follow block up against the chuck and turn it down to a diameter of 2¼ in. The follow block must always be smaller than the bottom of the chuck.

### The Bowl-Base Chuck

Turn a piece of hardwood (birch, maple or dogwood) to a 3-in. diameter. Fasten this to a faceplate and turn to the shape to be spun. Note the taper. The same follow block used for the bowl will suffice for the base chuck. See Figure 4 for base chuck setup.

### The Spinning Rest

In order to get the pressure required to force the metal over the revolving chuck, it is necessary to have a spinning rest with a row of holes for the insertion of a fulcrum pin.

This rest may be made from a ½ by 1½-in. iron bar. Drill holes along the center line of the bar, making a large hole for the center post. This post is to fit, and be fastened, in the regular lathe rest holder. See Figures 2 and 4.

### Fulcrum Pin

The fulcrum pin should be made about 5 in. long. Turn this out of a ½ or 5/8-in. iron rod. The part that fits into the spinning rest will be turned to fit loosely into the holes of the spinning rest, while the upper part of the pin should be of a somewhat larger diameter.

### Spinning Tools

Commercial spinning tools may be purchased after spinning has been given a trial. For this experimental project, use the end of a broomstick. Cut the stick 36 in. long so that it will fit under the arm of the spinner. Metal tools are superior to wood, since they burnish the metal rather than tend to collect it as is the case of wood tools.

### Setting Up the Lathe

Now that all preliminary requirements have been taken care of, we are ready to set up the lathe for spinning. Place the chuck on the lathe spindle. Set the spinning rest about 6 in. from the chuck. Fasten the rest securely so that the pressure of the tool will not cause it to move. Place the thrust bearing on the dead center, and place the follow block against the thrust bearing. Turn the dead center and follow block against the 7-in. by 16-gauge pewter disk that is placed between the chuck and the follow block, and fasten the dead center so that it will not move. Do not use too much pressure on the tailstock.

Set the lathe for a speed of about 1800 r.p.m., and start it in motion. Remember that the 7-in. disk is now in place. It may be off center. If so, stop the lathe and center it approximately. Another commercial method, much more difficult for beginners, is to start the lathe, hold the disk between the chuck and the follow block, then slowly draw up the follow block until the disk starts pulling. It may be off center. To center it, place a stick of wood on the inside of the fulcrum pin, use the pin as a fulcrum, touch the rotating disk with the stick of wood, releasing the follow-block pressure slightly until the stick of wood pushes the disk into proper center. When this is done, increase follow-block pressure and lock the tailstock spindle until the rotating disk is centered.

### Spinning the Bowl

With the disk rotating, touch it lightly with a white tallow candle so that its surface is lubricated and allows the spinning tool to move freely over the surface of the metal. Next, place the spinning tool under the right arm, over the spinning rest, on the left side of the fulcrum pin. Press the end of the spinning tool against the edge of the follow block as shown in Fig. 1, and exert pressure at this point so that the metal disk will become seated. Next, apply pressure to the disk, making the tool slide along the surface of the metal with a downward and outward motion. Do not apply too much pressure at the outer edge of the disk. This is what causes "rippling" or "wrinkled edge." If this does occur, take a stick of hard wood about 1 by 2 by 10 in. long, called the back stick, and place it against the left side of the disk. Hold the back stick in the left hand, placing the thumb of the left hand on top of the spinning rest. Now, by applying pressure on the back of the disk with the back stick and pressure on the other side with the spinning tool, it will be easy to iron out the wrinkles. This is done while the disk is in motion. Turn the disk until it fits the chuck. There will probably be some metal extending over the edge of the chuck. This is to be cut off. To do this, stop the lathe, set the rest up close to the chuck, put on a pair of goggles to protect the eyes from flying metal chips, and start the lathe again.

### Trimming the Bowl to Size

Take a 1-in. chisel and sharpen it on the right side just as it is sharpened on the end. Place the chisel on the spinning rest, hold it down tightly, and gradually draw it up against the edge of the bowl. Add pressure until the bowl is trimmed to the required size. Stop the lathe. Remove the spinning rest. Clean the metal bowl with 3/0 steel wool and old, fine-grit emery cloth.

### Spinning the Base

Set up the lathe with the base chuck, center the 4½-in. diameter, 16-gauge disk, and spin the metal over the base chuck. Trim the edge to the proper size. This requires a new operation at this point. The base center of this spun form must be cut out to make a ring for the base. For cutting the metal, take a square file, grind the point to a diamond shape. Set the spinning rest close to the metal, apply the tool as shown in the photograph, Figure 4. Cut through the metal. Remove the ring. The center that has been cut away may be used for making a smaller base.

### Solder Base to Bowl

We now come to a very important operation of pewtercraft. Soldering will cause trouble if extreme care is not exercised and several practice solderings done before trying to do a finished job. Find the center of the bottom of the bowl. Scribe a circle just a trifle smaller than the inside diameter of the ring base that was just made. Set the ring on the bottom of the bowl, flux the joint, use the turntable soldering method, and proceed to solder the base to the bowl. Play the flame on the large piece, then gradually bring it to the joint. When the flux boils, touch the joint with a finger of 65/35 pewter solder. Keep the solder on the joint until it flushes. Wash off the flux.

### Construction of Handles

Use 14-gauge B & S pewter for the handles, with 3/8-in. outside diameter tubing or rod to add the modern touch. Cut the handles to the dimensions shown in Figure 1. Saw one side to conform to the contour of the bowl. File the other side to a bevel so that it will fit the rounded surface of the 3/8-in. tubing or rod. Place the handle on a block of wood, set the tubing in place, flux the joint, play the flame on the joint until the flux boils, then touch the joint with a piece of 65/35 solder. When the joint is sufficiently heated, the solder will melt. *Do not use too much solder.* A good joint will not show much solder. Next, turn the bowl upside down on a large piece of wood. Set the handle i place, apply pewter flux to the joint, heat the joint until the flux boils, touch the joint with a piece of 65/35 solder, if the solder melts, all is O.K. If not, add more heat to the joint.

### Finishing the Bowl

Clean the bowl with 3/0 steel wool. Dip the wool in water, then in fine pumice stone. Rub the bowl thoroughly with this combination. Wash in water. Olive oil and powdered pumice stone will give a very fine satin patina to pewter. Apply this with a soft cloth. For a high finish, polish on a power buffer, or use 3/0 steel wool. To keep pewter clean, use Bon Ami, whiting, or use a good brass polish.

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### A Most Serious Problem

"It is the first of all problems for a man to find out what kind of work he is to do in this universe."

—*Carlisle.*

# INDUSTRIAL ARTS and VOCATIONAL EDUCATION

J. J. Metz, Editor

## Recording Man's Progress

Man's progress depends in great measure upon his knowledge of what other men have done. The Wright brothers took the meager information that other experimenters on gliders and airplanes had gathered, and building on this, finally, after much experimenting of their own, produced a heavier-than-air flying machine.

Others, carefully studying what had gone before, changing a little here and adding a little there, then boldly trying out entirely new schemes, have now altered the Wright airplane so that there is little resemblance between it and the modern multi-passenger airplanes that travel from the Pacific Coast to the Atlantic Coast between sunup and sundown.

Unfortunately, man has not always been careful in recording his discoveries, results of experiments, studies, and inventions. His neglect to do this has been detrimental to human progress.

Ask any engineer whether he knows who invented the gear wheel, the pulley, or the use of belts, and he will have to admit that he does not. Of course, this is not so likely to happen now where the printing presses are running night and day, recording even the most casual news. Yet, even today we are carelessly allowing much worthwhile knowledge to die because there is no one to preserve the record even if that has been made.

This world, therefore, owes much to the careful delver after truth, who not only notes down what he finds, but also preserves it for the use of future generations. Teachers of industrial arts and vocational education should be proud of the fact that they have such a historian among them in the person of Charles A. Kunou, assistant supervisor in charge of manual education, Los Angeles, Calif.

For years and years he has studied, written, and contributed to the history and progress of industrial arts and vocational education in America. Carefully methodical, he saved this material, and now to make sure that this accumulation of his lifetime may do the most good, he contributes it to one noted for his interest in research work, Dr. William E. Warner, Department of Practical Arts, Ohio State University.

This disinterested gift, includes 15 letter files, some of the correspondence dating back to 1889, many reports, wall charts, photographs, booklets, and blueprints. It gives much valuable material to the students of the Ohio State University. May they receive it gratefully and may they learn much from it, especially the value of carefully reporting, generously distributing, yet jealously preserving everything that may contribute to the progress of their profession.

There may be, and undoubtedly are, many such letter files and accumulations of information about industrial arts and vocational education scattered throughout this country. Will there be more Kunou's who will help preserve it?

## Timely Thoughts

"'The time has come,' the walrus said, 'to think of many things,'" and while the shop teacher during the summer vacation may not care to think about cabbages and kings, he may yet find it profitable and helpful to give some thought to the new school year that will start in September. It will be well for him, therefore, to cast a retrospective glance over his teaching experience to determine for the coming year which of his teaching methods, shop-management schemes, toolroom practices, demonstrations, individual instruction sheets, projects, progress and attendance chart schemes, and grading methods he ought to retain, which to alter, and which to replace.

He may even find it profitable to set aside a short period every day in which to spend a little concentrated thought and effort on this retrospective study which is to lay a good foundation for doing a little better that which has been done in the past.

The first thing which he ought to scrutinize is the course which he is teaching. Does it fully fit the purposes for which it is given? Are these purposes definitely outlined so that both the students and others may know just why this particular shop course was made part of the curriculum offered in a given school or school system?

Having settled this first problem, the next is: Does each unit of instruction directly assist in furthering these course objectives? Frequently this very necessary criterion of the value of a lesson is overlooked, with the result that in some industrial-arts classes vocational work receives too much emphasis, while on the other hand there are vocational classes in which work of a decidedly industrial-arts slant is given to the students.

Next comes the matter of improving, if possible, the physical equipment of the school shop. Are the benches arranged so that the students can work without interfering with one another? Has a study been made of the flow of work and of material through the shop? Are the tools and the equipment in proper condition for the opening of school? If not, what can be done about it and when? No doubt, all of this should have been settled before, but circumstances may have made this impossible.

How about the list of projects? Can a greater and better variety be included in order to give students a better choice? Have good samples of representative projects been prepared, or is it not time now to begin on their preparation? Do the projects chosen for the new school year portray the fact that there still are many students who will be unable to pay for the materials and supplies used in the shop?

Can the illustrative material which was used last year, and probably for some years before, be reconditioned, or should it be replaced? Can its scope and variety be increased? Has a bulletin board been used? Has a definite schedule for the use of bulletin material been worked out?

Does the tool-storage and dispensing method need improvement or alteration? Has the present method been successful in keeping down tool losses? Must some of the tools be reconditioned before the opening of school? Have provisions been made for taking care of this?

Can the method of grading and of recording grades and student progress be improved? Has a definite demonstration program been laid out? Can these demonstrations be given so that every student will derive the greatest benefit from them?

There are many other things that the ambitious shopman may want to scrutinize, alter, and improve in his course or in his shop, and as he delves further and further into the problems which he will uncover as he studies, he will readily admit that this is the time "to think of many things."

# The Making of Arrows

## W. Ben Hunt

*Handcraft Instructor, Boy Scout Troop 98*
*Hales Corners, Wisconsin*

*A fine article on this subject. It covers cheaply made arrows, target arrows, hunting arrows, flight arrows, footed arrows, and blunt arrows.*

THE most exacting part of making archery equipment is the production of the arrow. An Indian once said to Will Thompson (father of archery in this country as far as the white man is concerned), "Any old stick for a bow, but an arrow should be perfect." If the shaft is warped, or the pile is askew, or the feathers are put on wrong, an arrow will not function properly. Neither will an arrow with a shaft that is too thick, too heavy, too thin, or too weak. The standard diameter for a target arrow is 5/16 in., for a hunting arrow ⅜ in., while a flight arrow used only for distance, may be ¼ in. at the thickest part, and 3/16 in. at the thinnest.

All three of these styles of arrows will be described in this article. While the easiest way of making arrows is to buy 5/16-in. dowels of birch or of Port Orford cedar, good arrows may be made without incurring much expense.

### Inexpensive Arrows

Along country roads and in woods, one may find shoots of ash, hazel nut, willow, alder, or any other straight shoots that have no small branches. They should be about ½ in. thick at the butt and should not taper too much. Cut them about 30 in. long, and peel off the bark before it dries. Then take a bunch of 15 or 20 and tie the butt ends together with some heavy cord as shown in Figure 49.

*Fig. 49*

By bending and forcing a little here and there, they should be laid quite straight. Then starting at the butt end, wrap them together as tightly as possible, carrying the wrapping all the way up to the thin ends, and always watching that the shafts are laid, straight. Tie the end of the bundle securely, as shown in Figure 50, and hang it up to dry with the butt

*Fig. 50*

ends down. If hung in a dry place, the shafts will be in condition in about a month or two, and will then be quite straight, although there may be slight irregularities.

Now take a 1-in. board about 30 in. long, and 2½ or 3 in. wide and cut a V out of one edge. See Figure 51. Regardless

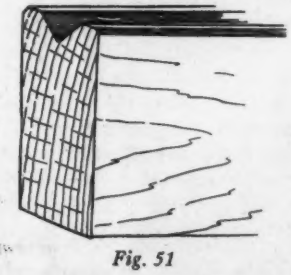


*Fig. 51*

of the kind of arrows to be made, this will be found to be an exceedingly handy jig. Drive a nail or a screw about ½ in. from the end, as shown in Figure 51 to act as a stop for the arrow to rest against while it is being worked upon.

Square up the shaft by cutting about ½ in. off the butt end, then cut them to a uniform length of 28 in. Place the V board in a vise and lay the shaft in the groove with the butt end against the nail, and dress it down with a small plane, turning the stick after every cut to keep it round. These arrows need not be of uniform diameter, that is, the butt may be slightly thicker than the nock or feathered end, but the shaft should be even and smooth and have an average diameter of about 5/16 in.

The next step is to sand each stick carefully. The butt ends may then be wrapped for ½ in. with what is known as stovepipe wire, and a nail or screw driven in as shown in Figure 52. This will make a fairly good arrow point, or pile, as the archer would say.

The shaft is then ready for the nock. Clamp the shaft into

*Fig. 52*

the vise. For this purpose the vise jaws should be equipped with wood faces into which depressions have been filed so that the shaft may be held without being defaced with vise marks. See Figure 53.

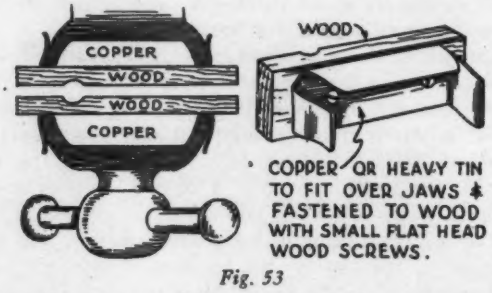



*Fig. 53*

Cut the nocks with three hack-saw blades fastened or tied together. This gives them the correct width. The depth of the nocks should be 3/16 in. to ¼ in. and the bottom should be rounded out with a rat-tail file. The end of the shaft should then be rounded off as shown in Figure 54 with

*Fig. 54*

a flat file or a piece of sandpaper. The shafts are then ready for the feathers. Putting on the feathers is called fletching the arrow. For arrows to be used for roving or just shooting around where arrows are likely to be lost, almost any kind of large wing feathers will do. Very nice arrows have been made with pigeon, chicken, and duck feathers.

Cutting feathers for arrows troubles many archery enthusiasts, but it really requires patience, rather than skill.

Make a feather clamp by soldering two pieces of iron or brass to a large paper clamp as shown in Figure 55. Strip

off the narrow vane of the feather by grasping it as shown in Figure 56 and pulling it off. Then with a shears, cut away ½ of the stem, cutting along the indentation on the hollow side of the stem as indicated in Figure 57. Another way of handling the job is to cut the feather into 2½-in. or 3-in. sections. Then place one section into the clamp as shown in Figure 58, after which most of the stem may be cut off with a sharp knife.

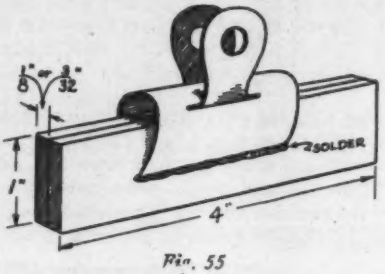


Fig. 55

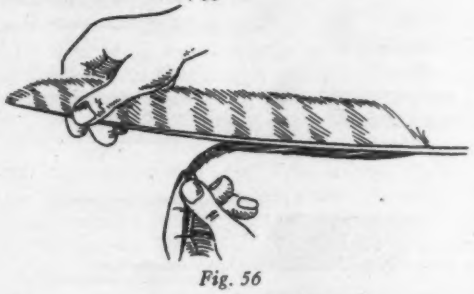


Fig. 56

Fig. 57

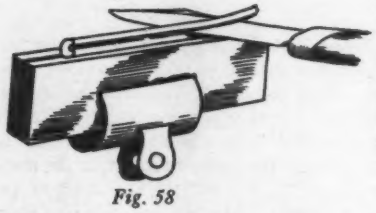


Fig. 58

Next tack a piece of coarse sandpaper, or better still, emery or carborundum cloth (coarse) to the top of a table

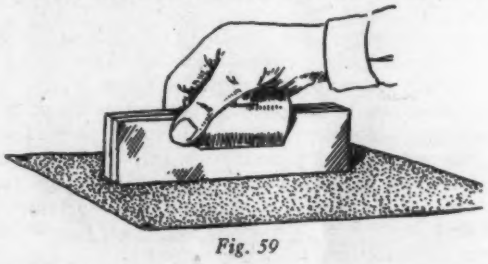


Fig. 59

or workbench, and holding the clamp as shown in Figure 59, at right angles to the abrasive cloth, grind down the rest of the stem, rubbing lengthwise, until only a very thin strip is left for holding the vane. If a sanding disk is available, the stems may be ground off on it. All that will be needed is a rest which permits holding the clamp at right angles to the disk.

It will be noted that one side of the stem that is left will be thicker than the other. This is as it should be, as it will help to set the feather with its curve correctly on the shaft. See Figure 60.

All the vanes on an arrow *must* be from feathers from the same side of the bird. A set of matched target arrows should also be all from one side of a bird.

If you have white feathers as well as gray, cut one white one to every two of the gray ones. This white feather will be the cock feather on the arrow, that is, the feathers that are fastened at right angles to the nock. See Figure 61.

After the feathers are all ground down properly, take a thin shears, and, laying the feather down on the bench, hollow side up, cut off the surplus stem as shown in Figure 62.

Now a rig to hold the arrow while setting the feathers in place is needed. In Figure 63 is shown one made of a box, the sides of which have been cut down to about 2 in. in height. In the center at one end, and ¼ in. from the upper edge, a hole 5/16 in. in diameter has been bored. This is to take the nock end of the arrow, and a small piece of wood should be fastened over the outside of the box, so that the arrow, when placed in position, cannot slide through. At the other end, a V is cut. This should be deep enough so that the arrow lying in it will be parallel with the sides of the box. This box will also be used in painting crests.

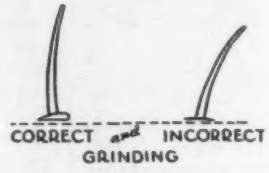


Fig. 60

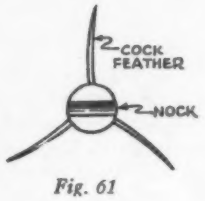


Fig. 61

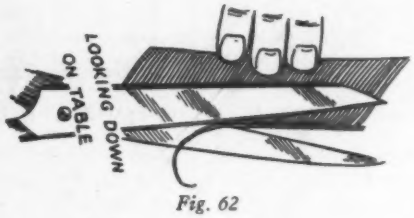


Fig. 62

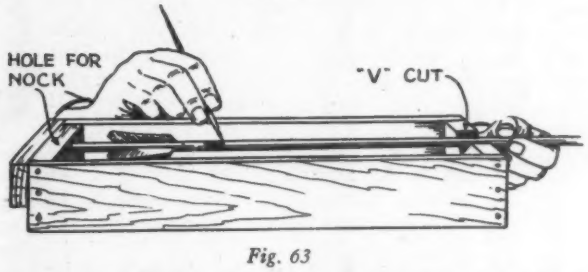


Fig. 63

The next step is to locate the positions of the vanes on the shaft. See Figures 61 and 64. Draw a line around the shaft

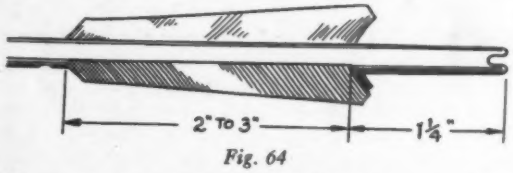


Fig. 64

1¼ in. from the nock end and another 2 in. or so beyond that, depending upon how long the vanes are to be. Then run a line for the cock feather which should be located at right angles to the nock, using the fingers for a guide. The other two feathers should be located 1/3 of the circumference each side of the cock feather. See Figure 65. With a little practice, it will be found easy to locate the positions of the three feathers. Next place the shaft in the box. If Dupont's household cement is to be used, run it along the stem of the vane, by holding the vane in the left hand and gently squeezing the cement out of the tube while moving it along. See Figure 66. One must work fast as this cement dries

quickly, so as soon as the cement has been put on the vane, place the feather along the mark on the shaft. Be careful that the vane is perfectly straight and even, and press it down firmly on the shaft. If the right amount of cement is used, it

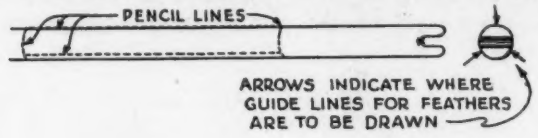



*Fig. 65*

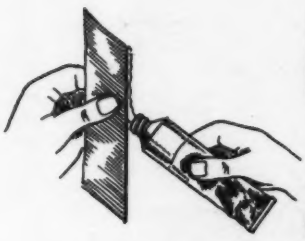


*Fig. 66*

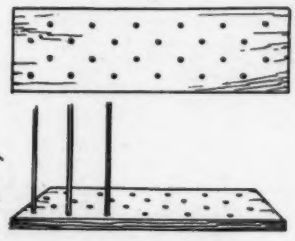


*Fig. 67*

will set in a short time. If too little is used, it will not hold well, while too much takes quite a while to set. The film of cement should be approximately 1/32 in. thick. Watch the vane for a few moments after letting go of it, to see that it is well fastened. Some fletchers use pins to hold the vanes in place until the glue has set properly. Then proceed to put on the other two. If possible, use a white feather for the cock feather. The other two should be natural dark feathers. If casein or fish glue is used, it is necessary to use pins to hold the feathers in place until the glue is dry.

As the fletching on each arrow is finished, set it up on the drying board shown in Figure 67. This is made by boring 5/16-in. holes ¾ in. deep in a board 1 in. or more in thickness.

Next cut a brass or tin template to the shape chosen for the feathers. Lay this on the feather with the straight edge against the shaft, and trim off whatever extends beyond it, with a sharp shears. Figure 68 shows some of the shapes in use.

*Fig. 68*

Trim off the forward end of each vane, where it is glued to the shaft, very carefully. Rough ends at these points may cut the archer's hand while shooting.

### Target Arrows

Any arrow made out of a single piece of wood is called a self-arrow. Excellent self-arrows may be made of birch dowels. They can be purchased from dealers and manufacturers of millwork, cabinetwork, and upholsterers' supplies. They should be straight-grained and should be sanded very smooth. Straight-grained spruce, or pine, also makes good arrows. The best arrow shafts, however, are of Port Orford cedar which can be obtained at archery supply houses. If bought or cut in ⅜-in. squares, they must be rounded. To do this, lay the square in the groove of the V board (see A, Figure 69), and plane off as shown. Then, turn it and do likewise with the other corners as shown at B, C, D, Figure 69. The shaft is now octagonal in shape. By laying it in the V with one edge up as at E, and taking off a little of each edge, a fairly round shaft is produced. Then sandpaper is used to take off the little corners that are left, leaving the shaft in the V and turning, while doing the sanding.

Shafts which are used for target work are tipped with parallel or bullet points (see Figure 70), the parallel being

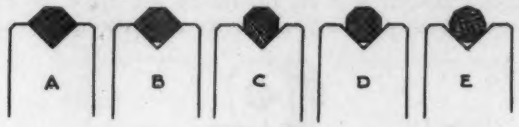



*Fig. 69*

preferred, because they do not penetrate into the target so far. They cost about 3 cents each, and can be had in steel or brass. The shafts are whittled or filed down to a snug fit, as shown in Figure 71, and driven down carefully with a piece of wood. Be sure that the end of the shaft goes to the end of the pile and that the pile is on perfectly straight.

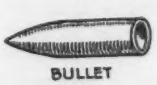


*Fig. 71*

*Fig. 70*

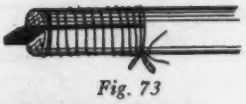


*Fig. 73*

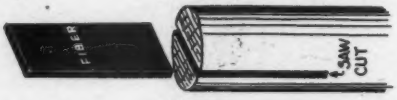



*Fig. 72*

When Port Orford cedar, spruce, or pine shafts are used with a bow pulling 40 pounds or more, it is sometimes well to put a fiber spline into the nock end of the arrow to prevent splitting. For this purpose black or red fiber about 1/32 in. thick is used. With a fine saw, cut a slot about 1 in. long, this cut going in the same direction as the annual rings, as shown in Figure 72. Try out the saw cut first to see that the fiber fits in snugly. Then put fish glue or casein glue into the cut and on the spline and drive it in place. Wrap string around the end as shown in Figure 73 and set aside. After the glue has dried thoroughly, cut away surplus fiber, and cut the nock at right angles to the fiber. The arrow is ready to be finished. See Figure 74.

Before cutting the nock, examine each shaft to determine the direction in which the annual rings run. Then cut out the nock at right angles to these rings. See Figure 75.

The procedure to be followed for fletching target arrows is the same as that already described. Turkey pinion feathers are commonly used for target arrows, although goose feathers are preferable as they possess more oil than do turkey feathers, and therefore can withstand dew and rain better. The wing feathers of hawks and large owls also make excellent arrow feathers, but are quite scarce.

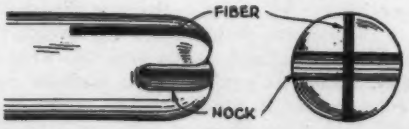



*Fig. 74*

*Fig. 75*

After the glue on the vanes has dried thoroughly, the arrows are ready for the final finish. Most archers have their own private crest on each arrow. These are put on just forward of the feathers. They may be any combination of colors that appeals to the individual. The colors should be chosen carefully, because certain colors are easier to find in the grass than others.

There are several ways that may be used for finishing arrows:

*a*) The crest may be painted on the raw wood with water color, enamel, or colored lacquer, and the entire arrow then finished with white shellac.

*b*) The crest may be put on the raw wood with water colors and the entire arrow finished with lacquer.

*c*) The shaft may be shellacked first and the crest painted on with enamel or colored lacquer.

*d*) The shaft may be first lacquered and a crest then painted on with colored lacquer.

No matter which method is chosen, no finish should be allowed to get into the nock.

Very fine black lines where two colors meet make the crest look more finished. See Figure 76. The archer who desires to

*Fig. 76*

have his name on his arrows may letter it between the vanes before the final coat of shellac or colorless lacquer is applied.

Be sure to get this final coat over the glued parts on the vanes in order to prevent future damage due to moisture.

### Hunting Arrows

Every man and boy interested in archery will at some time or other make some hunting arrows, regardless of the fact that very few ever get the chance to shoot anything larger than a rabbit. Hunting arrows, however, look very nice when made up. Indians used barrel hoop iron arrow heads,

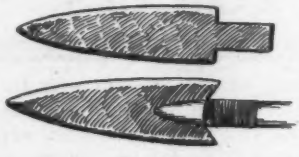


*Fig. 77*

filed and fitted as shown in Figure 77. They usually tied these heads in place by wrapping wet sinews about the end of the shaft. The shrinking of the sinews as it dried, held the arrow head firmly.

The modern archer, however, is not satisfied with this type of hunting point. To make an up-to-the-minute hunting arrow head, get some bronze 30-caliber bullet points, and some saw steel. Carefully saw a slot into the end of the bullet

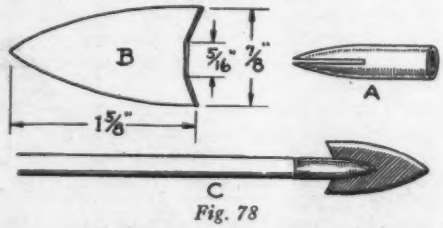



*Fig. 78*

point, as shown at A, Figure 78, with a hack saw. Cut, file, or grind the sawsteel to the shape shown at B in Figure 78, and drive it in place. Put the point on a piece of dowel rod for easy handling, and apply liquid flux. Then solder the two parts together. If the solder doesn't want to take hold as it should, put on more flux while the point is hot and try again. File off the surplus solder and file or grind a sharp but rough edge on it.

These arrows are very dangerous and should be used with utmost care.

### Flight Arrows

Of all the types of arrows used today, the flight arrow is the lightest, thinnest, and most graceful. They should be made of light but tough wood. Port Orford cedar, Norway pine, and spruce are well suited for this purpose. They should be of the same length as the target arrows. At the tip and the nock they should be about 3/16 in. in diameter and about 11 in. from the nock end it should be 5/16 in. or ¼ in. See Figure 79. This is what is called a barreled arrow and the taper from the thickest part to the ends should be graceful and gradual. Twenty-five-caliber bullet-point tips are just

*Fig. 79*

right for flight arrows but are hard to get. The writer made some aluminum and brass tips on a wood-turning lathe and has seen some made of horn and fiber. The arrow, however, should have some sort of tip to protect it in its fall.

The feathers should be thin and stiff. Turkey tail feathers make fine flight-arrow vanes. Make the vanes quite small — 1¼ to 1½ in. long, and 5/16 in. high seems to be a good size. See Figure 76.

The nock must be reinforced in some way. Thin tubular fiber ¼ in. outside diameter and ⅜ in. long is fitted onto the shaft and glued on after which the nock is cut in. The nocks also may be reinforced by winding with silk set in glue.

### Footed Arrows

Target arrows of Port Orford cedar, spruce or pine are usually footed with hard wood. Beef wood and lemonwood are the woods usually used, but walnut, maple, or hickory also are serviceable.

Footings are cut ⅜ in. square and 8 in. long, with a slot cut down the center about 5½ in. long, as shown in Figure 81.

*Fig. 81*

*Fig. 82*

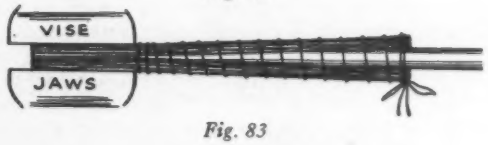



*Fig. 83*

Next take a 5/16-in. shaft and with a small sharp plane cut a 5¼-in. wedge shaped as shown in Figure 82, the thickness of the end to be the same as the width of the saw cut in the footing. Place the footing in the vise up to the saw cut, see Figure 83, put fish glue on the shaft and in the slot and force the shaft gently into the slot to the very bottom. Make sure that the footing is on straight and then wrap tightly with good stout cord. Set aside to dry for about 24 hours. Then unwind the cord and lay the shaft on a flat surface and with a sharp plane cut off the surplus wood, making the footing the same thickness as the shaft. Then turn it and plane the other sides until 5/16-in. square shaft is produced. See

*Fig. 84*

Figure 84. Lay the shaft in the V board and plane it around as you would another shaft, always cutting away from the footing, toward the other end of the arrow. Then sandpaper the shaft, put on the pile, and finish.

### Blunt Arrows

After shooting with bows and arrows for a short time, the archer no doubt will marvel at the way an arrow can lose itself in even the shortest grass and how a pointed arrow can bury itself for an inch or so in a tree trunk or branch so that it takes a half hour or more to dig it out.

For this kind of shooting, blunt arrows cannot be beat. If a lathe is available they may be turned easily but they also may be whittled out. Take a piece of maple or hickory ⅞ in. square or round and bore a 5/16-in. hole about ¾ in. deep in the end as straight as possible, as shown at A Figure 85. Put an arrow shaft in the hole to see how true it is. Then whittle it down to the shape shown in B. Put the shaft into the hole from time to time to be sure to get it true. Next smooth it off nicely with a file or with coarse sandpaper. Then whittle it off as shown at C, after which it is glued onto the shaft. After the glue is thoroughly dry, sand off the end smoothly, and then give the entire arrow a coat of orange or red lacquer. These blunt arrows have tremendous hitting power. They do not sneak under the grass as easily as do other arrows, but the chances of getting a rabbit with a blunt arrow are much better than with a hunting point. These blunt arrows will stand a lot of hard knocks too.

Remember to give all arrows a coating of shellac lacquer or varnish, and keep them in a reasonably dry place.

An oiled rag run over the arrows after shooting is well worth the effort and time it takes, and a little oil on the feathers does no harm either.

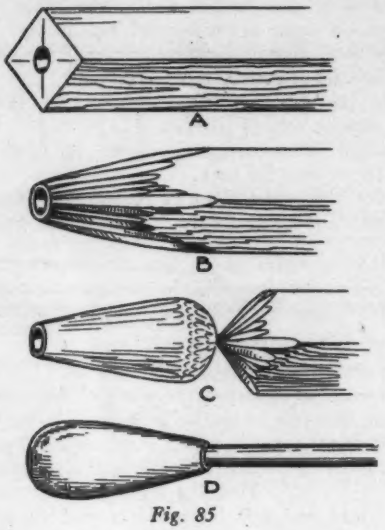



*Fig. 85*

# Problems and Projects

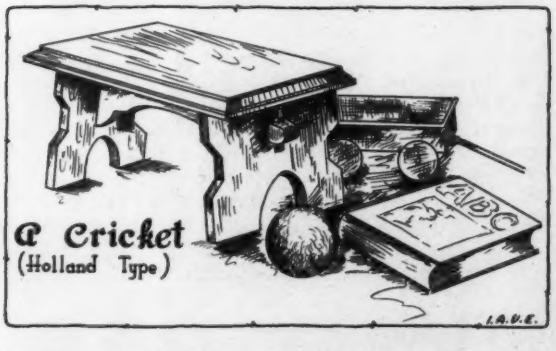
## A CRICKET

**J. I. Sowers, Director of Industrial Arts, Miami, Florida**

(See Supplement No. 314)

This rather pleasing little Dutch, or Holland type, cricket offers a good project for school-shop practice in the junior-high-school woodworking grades. It affords a piece of work of more than ordinary difficulty if made correctly and according to the drawing as given.

The name "cricket" is quite correctly applied to this type of stool, but is not in common usage in this country. The use of the word "cricket" in connection with a low wooden stool, is of uncertain origin. The more familiar stool to which this name is applied is the small, round, three- (sometimes four-) legged stool, with legs set at an angle of about 45 deg.




This is the English type cricket, and reference to it is frequent in English literature.

Calling the stool shown herewith a cricket, gives it a little more interest than if merely called a "Dutch stool." After all, there is something in a name.

With economic conditions as they are, small, interesting projects like this are of increased importance, and teachers of woodworking will continue to seek for small projects which embody the essentials of woodworking. It is with this thought in mind that this little cricket is offered.

The drawings are complete, so that comment on the manner of construction is unnecessary here. A stain and wax finish is all that is necessary.

These little stools are a choice possession in homes where there are small children. This is indicated by its being shown here in connection with children's books and toys.

## VISUAL AID CABINET

**Charles H. Folwell, Wilbur Wright Junior High School, Cleveland, Ohio**

Visual aids function only when they are large and clear enough to be seen by the entire class, are always readily available, and can be displayed so that all members of the class can see them.

Figures 1 and 2 show a storage and display cabinet for visual-aids material. Illustrative material of any description is mounted upon 22 by 28-in. mounting boards. For purposes of display before the class, these are slid into the grooved rails, as shown in Figure 2.

The cabinet is shown with the door open at the right-hand side. Within are stored the display cards, drawings, and samples that are needed for demonstration work. These cards are always available.

Drawings and sketches which are to be a part of the permanent teaching equipment will quite naturally be of a higher quality, more accurate, and clearer in detail than any hurried sketches that the instructor might place on a blackboard during a demonstration lesson. Consequently they will leave a better and more lasting impression on the mind of the pupil. Work placed upon a blackboard must soon be erased — and lost. Waste is eliminated and the time of the instructor is conserved by having permanent and lasting cards to display when needed. In case of a review lesson, the same visual aids are used. This is a decided advantage, as no two blackboard sketches are ever alike in all respects.

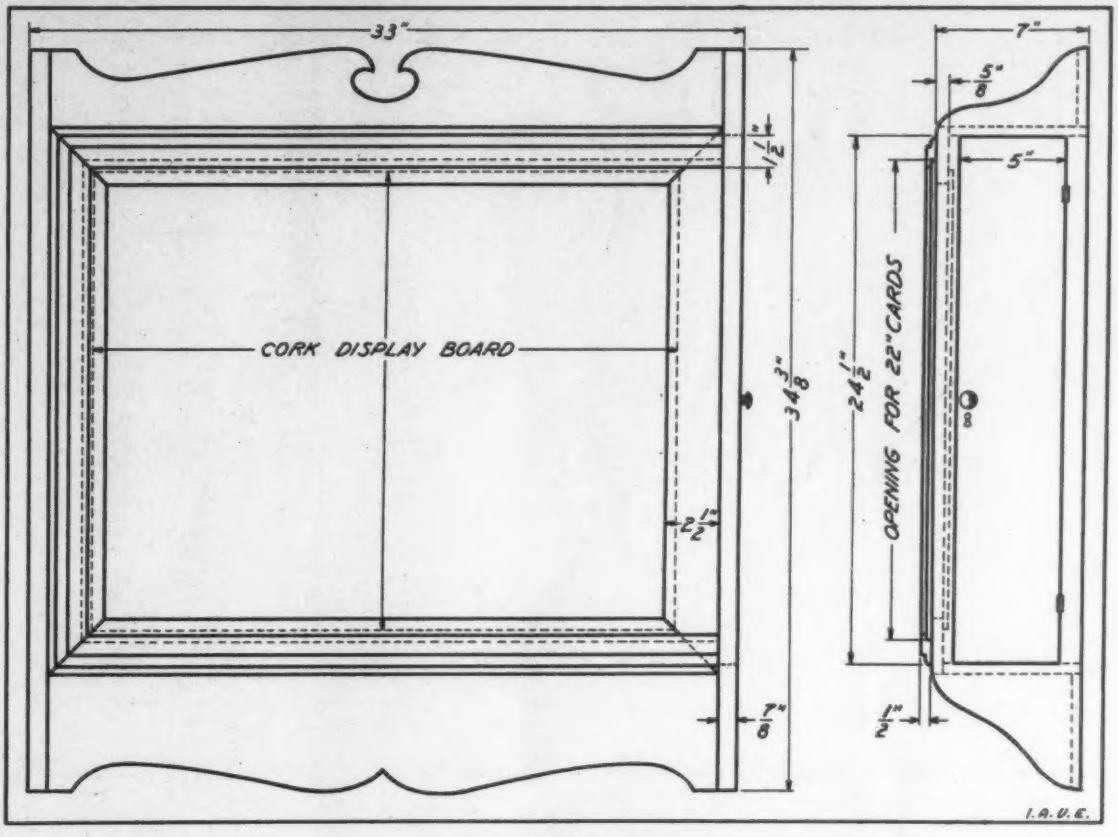



*Fig. 1. Visual Aid Cabinet*

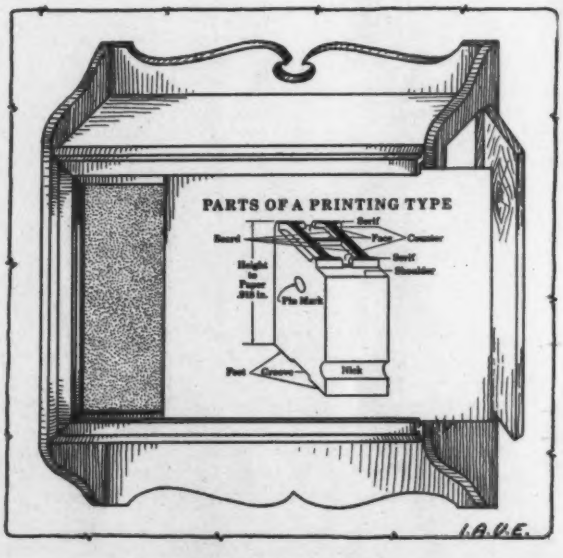
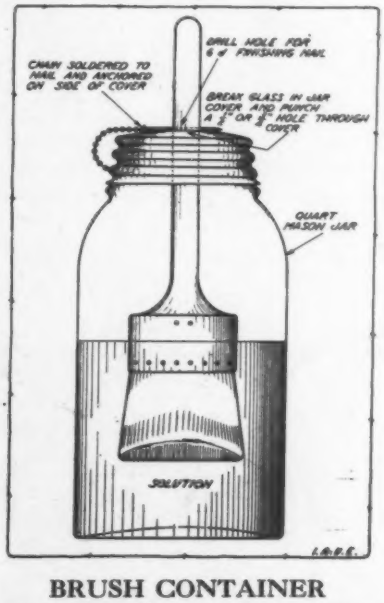



*Fig. 2. Visual Aid Cabinet in use*

The front panel of the cabinet is made of cork linoleum upon which may be posted bulletins and notices that are to be called to the attention of the pupils. The top of the cabinet may be used as a shelf — and shelves are always useful. Hooks may be screwed into the lower panel, upon which various articles may be hung. A lock on the door will keep the drawings safe from unnecessary handling.

The making of this cabinet forms a very good project for correlation of work in the mechanical-drawing, woodworking, and art departments. The cabinet itself can be part of the permanent equipment in any schoolroom.


DRILL HOLE FOR 6 d FINISHING NAIL
CHAIN SOLDERED TO NAIL AND ANCHORED ON SIDE OF COVER
BREAK GLASS IN JAR COVER AND PUNCH A 1/2" OR 3/4" HOLE THROUGH COVER
QUART MASON JAR
SOLUTION
I.A.V.E.

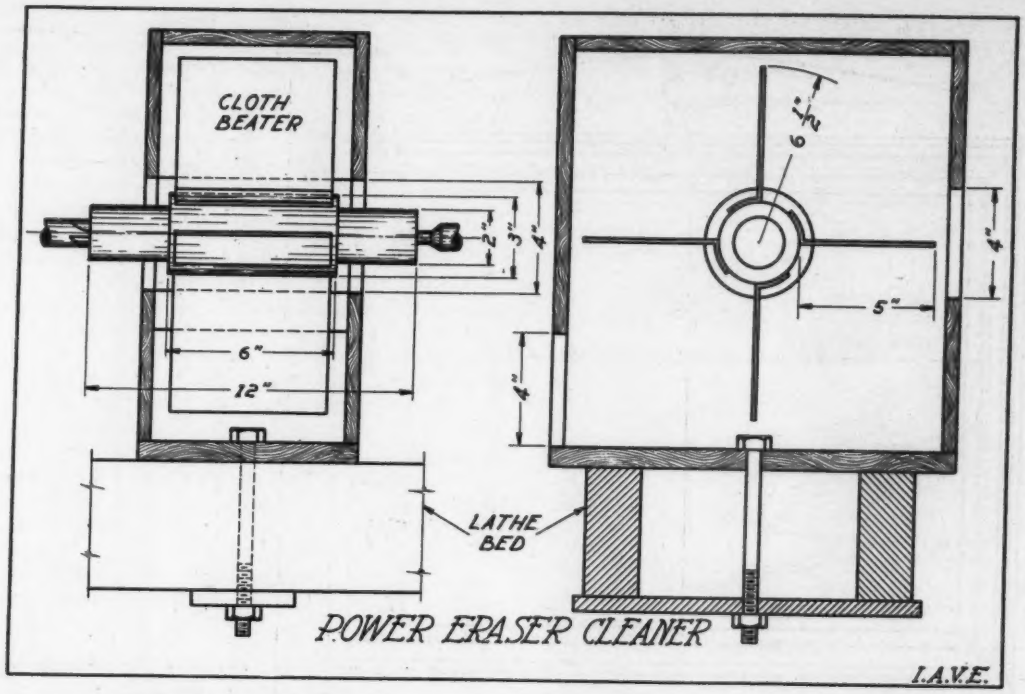
## BRUSH CONTAINER

**Louis Barocci, High School, Cudahy, Wisconsin**

Of the various brush containers in our shop, I have found this mason-jar brush storage the most practical as well as the most simple to make.

The illustration shows just how it is constructed.

A label glued to the outside of each jar indicates what type of solvent it contains.




## POWER ERASER CLEANER

**F. H. Parrish, Dallas, Oregon**

This is an eraser cleaner that is cheaply constructed, does a good job quickly, and saves the time, knuckles, and disposition of the janitor.

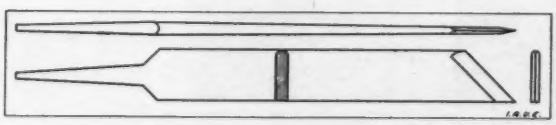
It consists of a wood roll held between the centers of a wood-turning lathe. The beaters are cloth — heavy burlap — folded to about four thicknesses and tacked to the roll, get out practically all the dust, and last a long time.

The cleaner is operated at about 1800 r.p.m. in the lathe. The housing was added to keep the dust from blowing directly in the face of the operator. The roll can be taken out of the housing through the openings in the sides. The opening in front will admit two erasers at a time.

## AN IMPROVED SKEW CHISEL

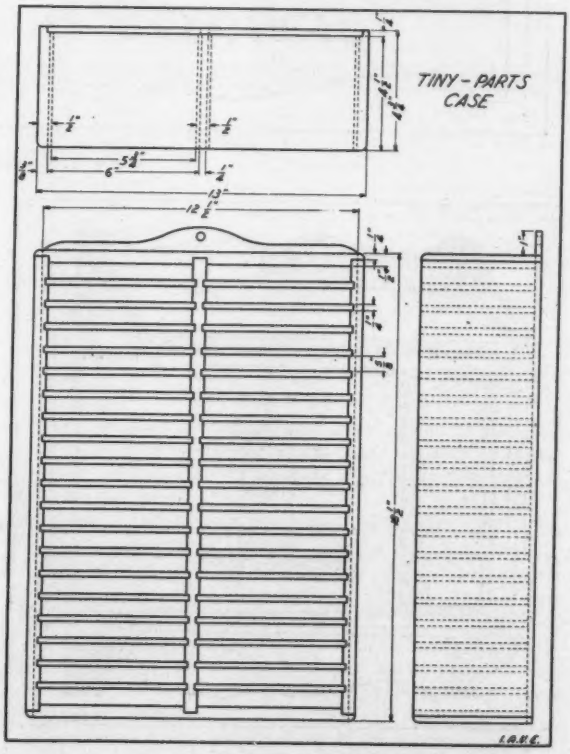
**O. K. Moe, State Normal College, Dillon, Montana**

My experience in wood turning and with wood-turning classes has led me to devise a change which improves the skew chisel. When the ordinary skew chisel takes a bite into the stock, the sharp edge of the chisel makes a nick in the toolrest. The next time the chisel is drawn across the nick in the toolrest, another bite is likely to occur because of the sudden stop produced by the sharp edge coming in contact with the nick.



*Skew chisel with rounded edge*

To avoid this repetition of bites, the lower two edges of the skew chisel have been rounded off as shown in Figure 1, and thus will operate as smoothly and freely as the gouge on the toolrest. The improved skew chisel has been in use for quite a while. It has been found to be very satisfactory and easy to operate.




## A TINY-PARTS CASE

**L. W. Bateman, Jr., Junior High School, Pacific Beach, California**

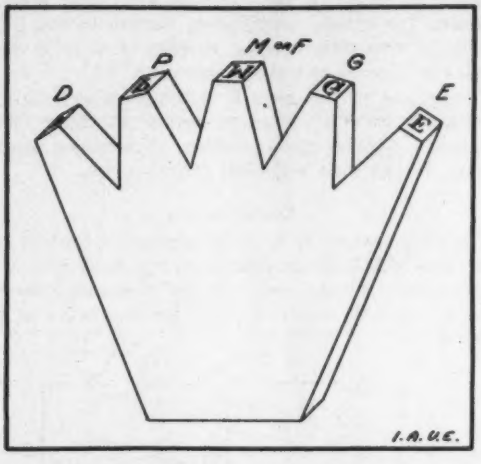
The case shown herewith is designed to hold 40 flat 50-cigarette tins as containers. These containers are excellent for storing the many tiny articles of material and supplies which need to be stored in the industrial-arts shop. The containers should all be labeled, for which purpose gummed labels, or adhesive tape lettered in India ink, will be found satisfactory.

The case may be finished to match the other shop fixtures.

## A USEFUL STAMP

M. E. Block, Collinwood High School, Cleveland, Ohio

In these days of large classes when innumerable papers must be graded, and when cards, records, and reports must be checked and marked, the stamp described herewith will be found to save much time and avoid many errors. It is




especially valuable when the marking and grading are done by students whose writing is frequently illegible.

The stamp shown is for stamping grades:

E — 93 to 100, Excellent G — 85 to 92, Good
M — 77 to 84, Medium P — 70 to 76, Passing
D — Below 70, Not Passing

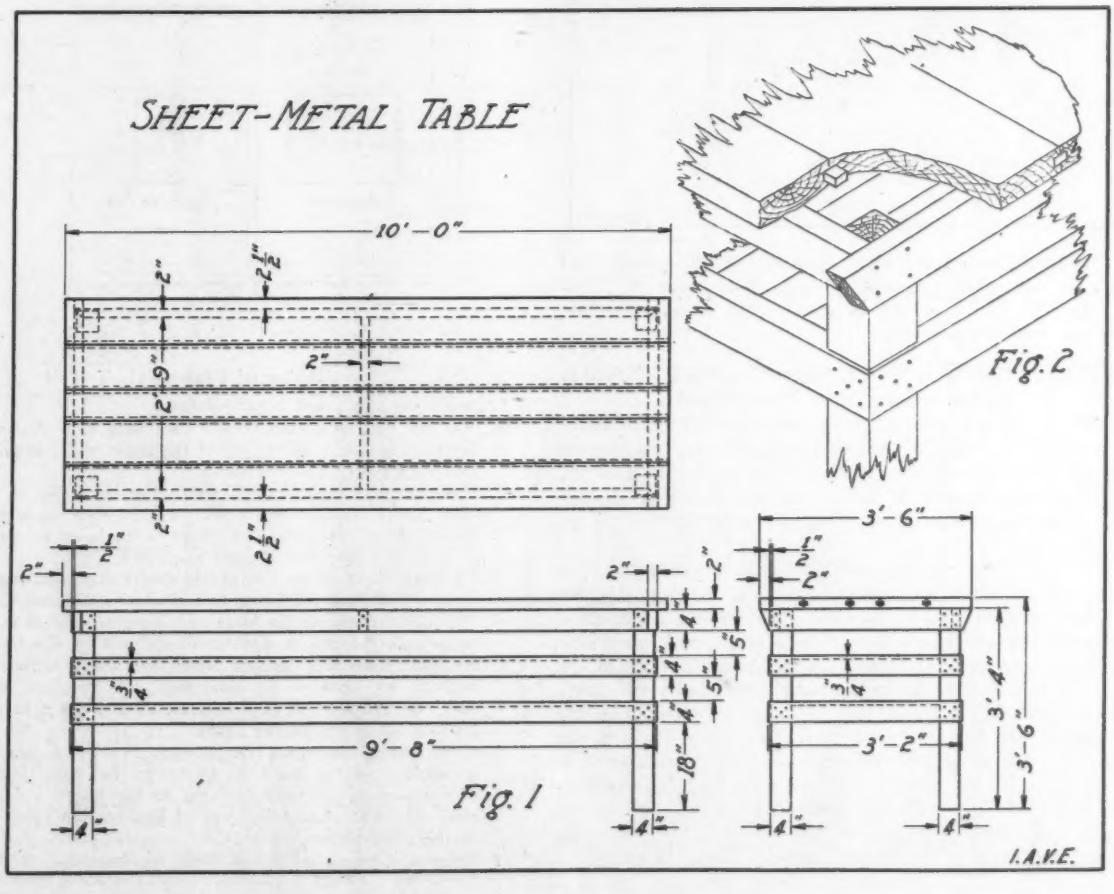
The single rubber letters, 14- or 18-point, are glued to the wood block. Each letter may be used independently, thus making it unnecessary to change continually from one stamp to another.

## A SHEET-METAL-SHOP WORKBENCH

H. C. Rose, High School, Augusta, Wisconsin

The sheet-metal workbench described herewith fills the needs of the small sheet-metal or general metal shop. It is sturdy in construction, yet cheap and practical, especially when limited space makes the storage of a supply of sheet metal a problem. The difficulty in this case is overcome by the use of two shelves beneath the top. If need be, the table may be equipped with three shelves.

The length and width were designed to fit the available floor space and to accommodate standard sizes of sheet metal



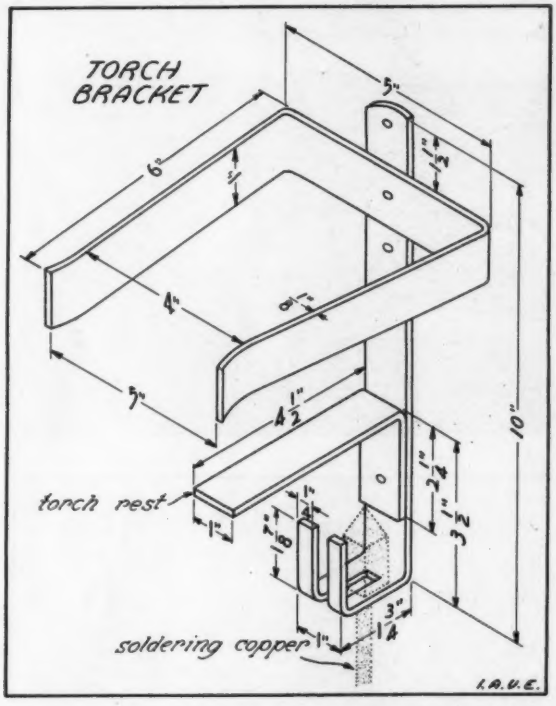
on the shelves. The safety and convenience added by the use of these shelves makes the construction justifiable.

Figure 2 shows the assembly and details of the bench and is self-explanatory. Hard wood should be used for the top.

## BLOWTORCH AND SOLDERING-COPPER RACK

**Carl v. Lindeman, Western State Teachers Training Unit, Paw Paw, Michigan**

The blowtorch and soldering-copper rack described herewith will appeal to the shop teachers who like to have tools in their proper places. The rack has been found to be very effective, in teaching the boys to replace the torch and soldering copper in its proper place.




The rack is very simple in construction and a very good project for junior-high-school pupils. It is made of ⅛-in. strap iron. The rack may be made larger to accommodate several soldering coppers.

## VISUALIZE—AN EDUCATIONAL GAME

**D. E. Kellogg, Erie, Pennsylvania**

There are a few days at the beginning of each school semester when the teacher hesitates to start his regular instructions on account of probable class-schedule changes. During this period it is difficult to find profitable employment for the student that will be interesting as well as instructional.

It is a commonly accepted fact that the keenness of a person's visualization power determines very greatly his ability to make and to interpret shop drawings. The game described herewith has been played at different opportune times in my drafting classes during the past year and the record of individual scores correlated very closely with their drafting ability. The fact that the objects illustrated by the thirteen sets of cards were selected to cover first-semester drafting difficulties facilitates the transfer of knowledge from the game to our orthographic sketching and instrumental-drawing units. Several of my students liked the game so well that they asked permission to take the cards home over the week-ends to play it with their fathers or older brothers.

The description and rules of the game follow:

This game "Visualize" is arranged for boys of the junior-high-school age who are about to make their first contacts with industrial practices. These industrial experiences require visualization. In the drafting room this visualization must produce mentally the separate related orthographic views of objects, either from the objects themselves or from pictures of them. In the shop practices, the process is reversed. The student must obtain definite mental pictures of objects from their working drawings. A working drawing consists of a group of orthographic views.

The purpose of this game is to create an immediate need for both types of visualization, and at the same time, by matching one player against another, quicken their perceptive powers through their individual desires to win.

### Organization

The game consists of 52 cards, arranged in thirteen sets of four cards each. Each set consists of a *pictorial view* of some simple object, and the *front, top, and right-side orthographic views* of the same object. Examine the illustrative set shown in Figure 1.

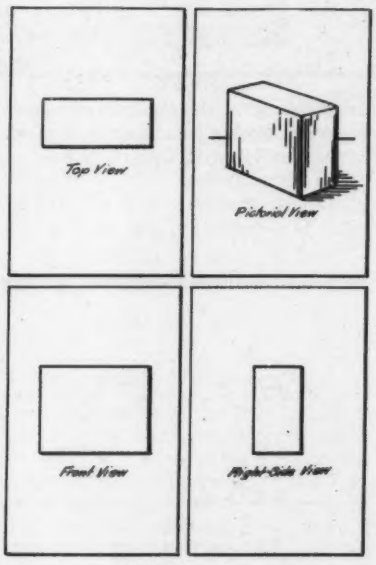


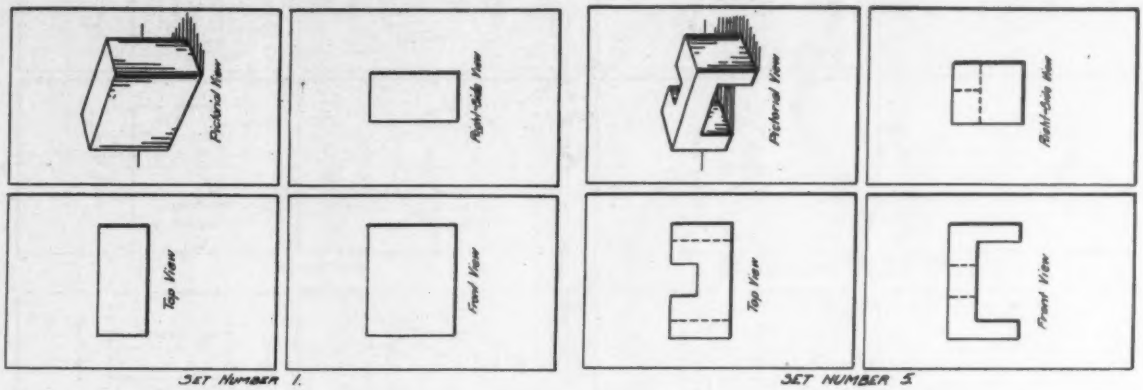

*Fig. 1*

### Rules of Play

1. Shuffle the cards well before dealing.
2. Deal one card at a time around the board in a clockwise direction, beginning at the left of the dealer and continuing until each player has four cards.
3. Turn the next card face up beside the remainder of the cards that are placed face down, or blind in a single pile.
4. The object of the game is to have each player to collect as many complete sets of cards as possible.
5. The play starts at the left of the dealer and continues in succession around the board in a clockwise direction.
6. The player examines his hand and compares the cards he holds with the one or more cards exposed on the board. He may choose any one of them that matches what he holds in his hand, or he may draw one from the blind deck. To complete his play he must discard one card face up with the others on the board.
7. If the player, during his turn at play, discovers a complete set exposed on the board, he may draw five cards instead of one, and discard only one after he has placed his complete set on the board in front of him for the inspection of the other players.
8. When a complete set is laid down for inspection, it must

be arranged with the top view above the front, the right-side view at the right of the front, and the picture view filling the remaining space at the upper right. (Examine the illustration at the beginning of these rules.)

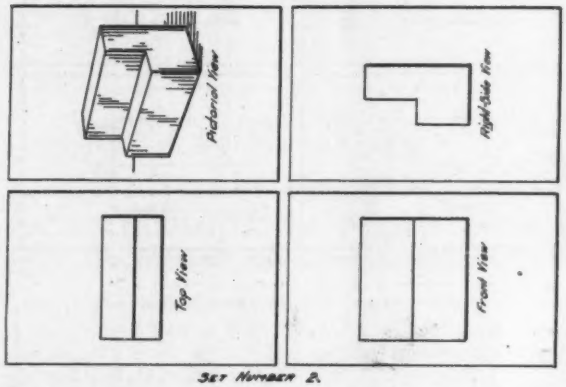
9. If the set placed for inspection has a wrong card in it, it must be returned to the board if it came from a five-card draw. If the set was played from the hand, the player is ordered to pick them up.



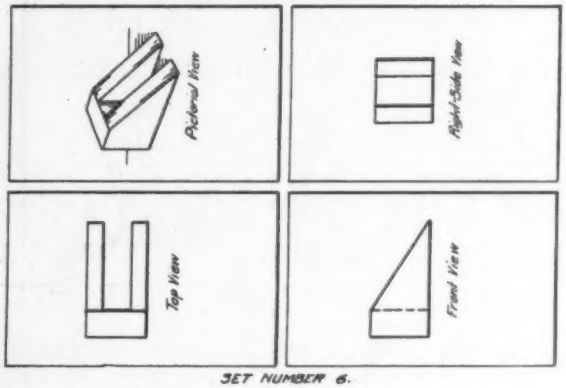

SET NUMBER 1.




SET NUMBER 5.




SET NUMBER 2.

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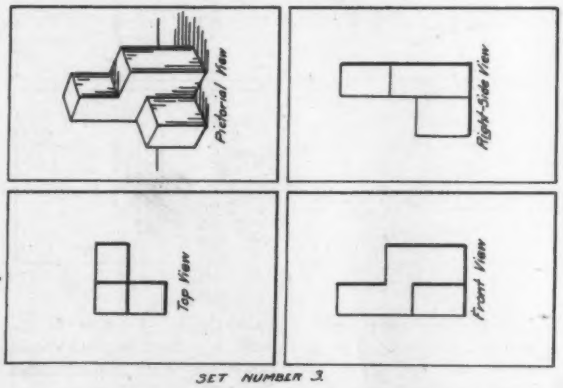


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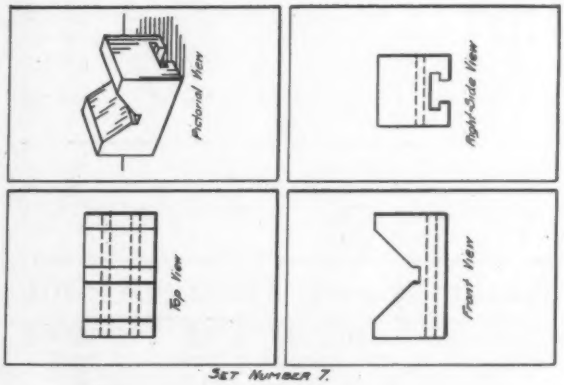


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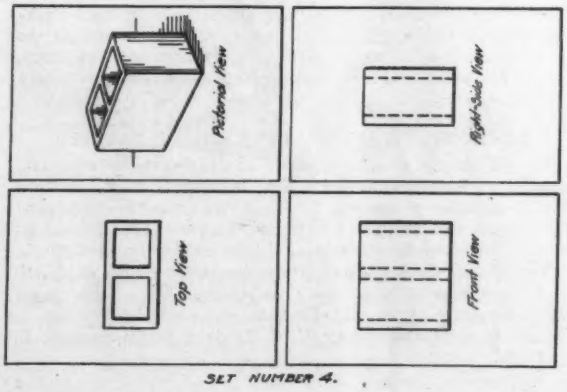


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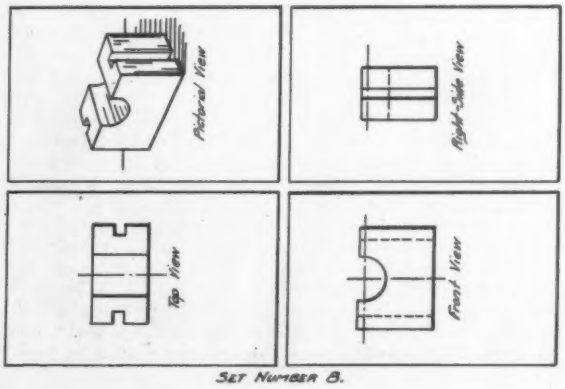


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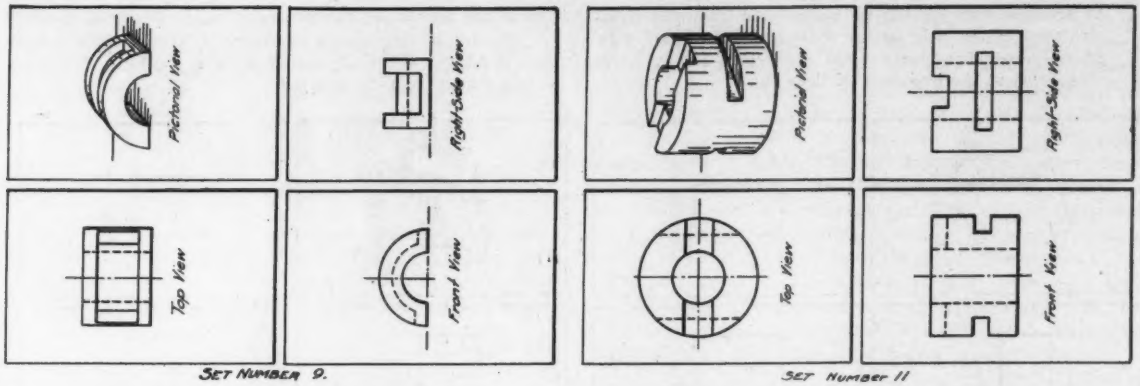
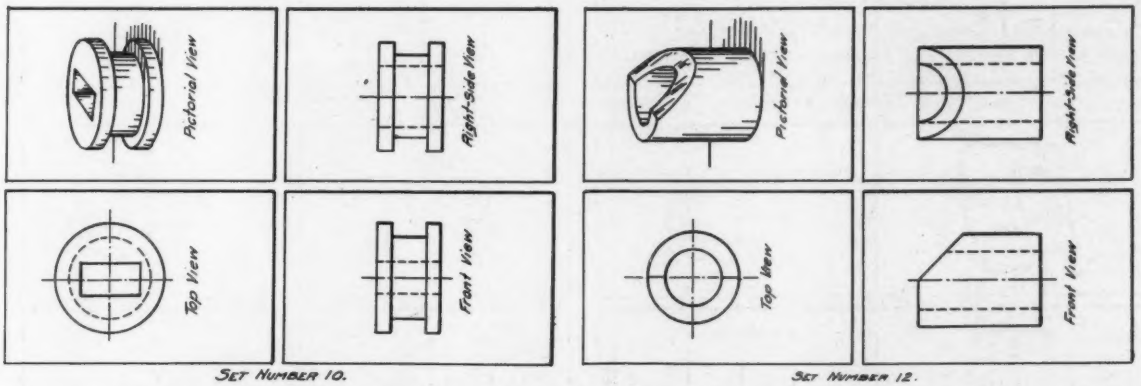
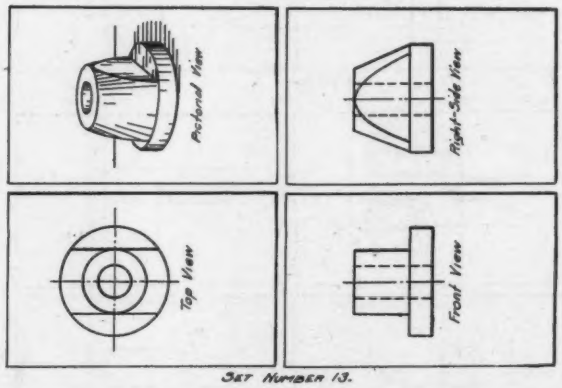



10. If the set has not been arranged correctly, the player who corrects the arrangement may take the set for himself.
11. When a player has laid down all his cards, he may when his next turn to play arrives, take a new hand from the blind deck and proceed to make a play.
12. When the blind deck has all been drawn, a player without cards may, when his turn arrives, still draw complete sets from the board. If no such draw is made, he passes and the play goes to next player.
13. When the game plays itself out for lack of cards, the last set on the board shall not be counted.
14. The game may be scored at the end of each hand, or after each player has had one turn at dealing.
15. The score is the total number of sets collected by each player. The player having collected the greatest number of sets wins.




# Associations, Conventions

## WESTERN PENNSYLVANIA INDUSTRIAL-ARTS TEACHERS MEET IN CALIFORNIA, PENNSYLVANIA

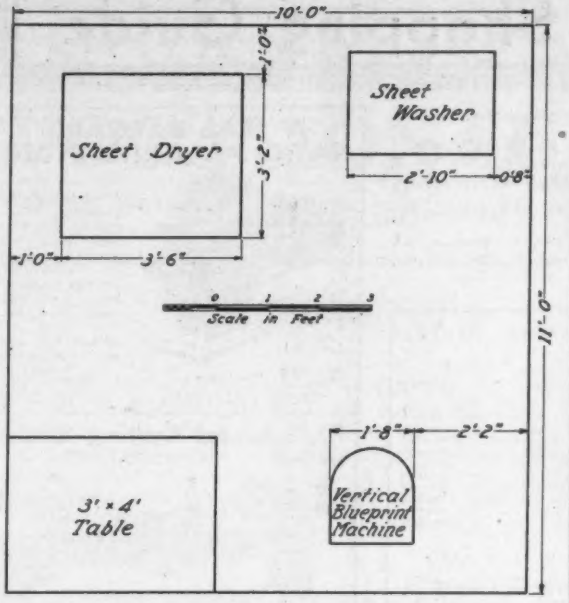
The spring meeting of the industrial-arts group of Western Pennsylvania was held on Saturday, April 6, at the State Teachers' College, California, Pa. There was an attendance of approximately 400 persons. Dr. R. M. Steele, president of the Association, had prepared an excellent program.

Mr. W. P. Loomis, of the Pennsylvania State Education Department, talked on "Foundation of Industrial Arts in the School Curriculum." Mr. R. W. Selvidge, of the University of Missouri, took as his subject, "Industrial Arts as a Part of General Education," pointing out examples of how instructional material can be organized to make the general education program enriched through an industrial-arts program. He cited many tests for use in the organization of industrial-arts programs. Prof. F. M. Leavitt, of Pittsburgh, conducted the discussion. Mr. John W. Friese, of the State College, read a paper on "Opportunities for Correlation," and John Backus discussed "Education Through Printing," telling how the type founders endeavor to make textbooks attractive. In the entire program emphasis was laid on the fact that the pupil should come first, and that courses, tests, and measurements are a scaffold that may be eliminated after the structure is completed.

There were a number of interesting exhibits, comprising a working exhibit of students in training in the college, an exhibit of the work of schools in the vicinity where teacher-training is conducted, and an exhibit of cold iron work and home-workshop machinery projects. — *George C. Donson.*

## EPSILON PI TAU FRATERNITY INSTALLED

The NU chapter of the Epsilon Pi Tau Fraternity was formally installed at Rutgers University, New Brunswick, N. J., on April 20. The initiation of members was conducted under the direction of the national secretary, Dr. William W. Warner of Ohio State University. Following the initiation, a dinner meeting was held at the Wilson Hotel, where a special program was carried out, with Dr. L. A. Emmerson, of New York as toastmaster. The officers elected were: President, Arthur F. Hopper; vice-president, Robert A. Campbell; secretary-treasurer, C. C. Sinclair; faculty sponsor, C. E. Parth.

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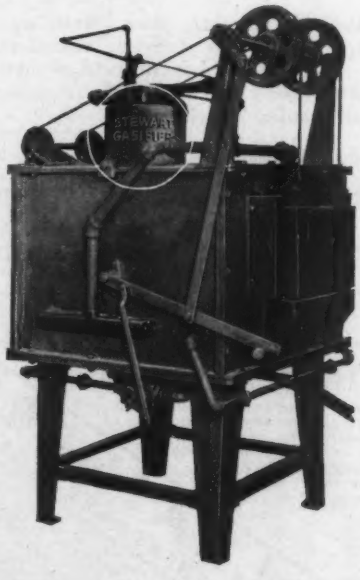
# SchoolShopEquipmentNews

### A NEW STEWART GASIFIER

The Chicago Flexible Shaft Company, 5600 Roosevelt Road, Chicago, Ill., is just marketing a new gasifier unit applicable to all industrial gas-fired furnaces.

The gasifier can be attached to any furnace using gas for fuel. It requires no additional floor space and makes use of the same burners.




Oil fed through this gasifier changes into a high BTU gas which costs considerably less than the usual fuel gas used.

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